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Part VI

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Office of Conservation and Solar Energy

Residential Conservation Service Program

DEPARTMENT OF ENERGY

Office of Conservation and Solar Energy

10 CFR Part 456

[Docket No. CAS-RM-79-101]

Residential Conservation Service Program

AGENCY: Department of Energy.

ACTION: Notice of proposed rulemaking and public hearing.

SUMMARY: The Department of Energy (DOE) is implementing the Residential Conservation Service (RCS) Program pursuant to Part 1 of Title II of the National Energy Conservation Policy Act (NECPA) (Pub. L. No. 95–619, 92 Stat. 3206, et seq.) The purpose of the Program is to encourage the installation of energy conservation measures, including renewable resource measures, in existing houses by residential customers of larger gas and electric utilities and home heating suppliers.

On November 7, 1979, DOE issued a final rule for the RCS program. (44 FR 64602). Included in the final rule were several reserved sections. This Proposed rule fills in these reserved sections, and proposes additional sections.

This Proposed Rule sets out requirements for certification of installers and inspectors of flue opening modifications (vent dampers) in gas-furnaces; installers and inspectors of automatic intermittent pilot ignition devices (IID's) in gas-fired furnaces; installers and inspectors of wind energy devices, and installers and inspectors of active solar space heating systems, solar domestic hot water systems, and combined active solar space heating and solar domestic hot water systems. The Proposed Rule also sets out proposed requirements for interim material standards and installation standards for urea-formaldehyde (U–F) based foam insulation; standards for thermosiphon hot water heaters; standards for solar swimming pool heaters; loading requirements for installation of loose fill thermal insulation; installation standards for caulks and sealants; material standards for pipe insulation; material and installation standards for flue opening modifications (vent dampers); standards for wind energy devices; and material standards for IID's.

DATES: Written comments must be received by February 19, 1980, 4:30 p.m., e.s.t., in order to ensure their consideration.

PUBLIC HEARING: January 21, 1980.

ADDRESSES: Comments and requests to speak at the hearing should be addressed to: Joanne Bakos, Office of Conservation and Solar Applications, Department of Energy, Mail Stop 2221C, 20 Massachusetts Avenue, N.W., Washington, D.C. 20585. See "Comment Procedures" under Supplementary Information below.

HEARING LOCATION: A Public Hearing will begin at 9:00 a.m., January 21, 1980, at Room 3000A, 12th and Pennsylvania Avenue, N.W., Washington, D.C.

FOR FURTHER INFORMATION CONTACT:

James R. Tanck, Director, Residential Conservation Service Program, Office of Conservation and Solar Energy, Department of Energy, Room 3128, 20 Massachusetts Avenue NW., Washington, D.C. 20585, (202) 376–4020.

Susan Caplan, Office of General Counsel, Department of Energy, Room 3228, 20 Massachusetts Avenue NW., Washington, D.C. 20585, (202) 376–4100.

SUPPLEMENTARY INFORMATION:

I. Introduction.
II. Qualification Procedures.
III. Proposed Standards.
IV. Regulatory Analysis and Urban Impact Assessment.
V. Environmental Impact Statement.
VI. Consultation with Other Federal Agencies.
VII. Contractor Contributions to the Rulemaking.
VIII. Comment and Hearing Procedures.

I. Introduction

The Department of Energy (DOE) proposes to amend Part 456 of Chapter II of Title 10 CFR to complete the rulemaking requirements for Title II, Part 1 of the National Energy Conservation Policy Act (NECPA), Pub. L. No. 95–619. Several areas in the initial proposed rules issued March 19, 1979 (44 FR 16546) were reserved pending further study and investigation. Among these reserved areas were qualification procedures for installers and inspectors of wind energy devices and furnace retrofit devices. Other reserved sections were installation standards for urea-formaldehyde foam insulation, vent dampers, and automatic intermittent pilot ignition devices (IID's). This proposed rulemaking fills in these reserved sections, replaces the previously proposed interim material standard for urea-formaldehyde foam insulation with a new proposed material standard and proposes installation standards for caulks and sealants.

II. Qualification Procedures

DOE determined that four program measures had sufficient potential safety hazards associated with the installation to merit special consideration. These measures included:

- Vent dampers.
- Automatic intermittent pilot ignition devices.
- Wind energy devices.
- Active solar space heating systems, solar domestic hot water systems, and combined active solar space heating and solar domestic hot water systems.
- U–F foam insulation.

Qualification procedures for the installers of U–F foam insulation are the responsibility of the manufacturer rather than the State and are addressed in Section IV below. Qualification procedures for installers and inspectors of vent dampers, IID's, wind energy systems, active solar space heating systems, solar domestic hot water systems, and combined active solar space heating and solar domestic hot water systems are included in § 456.314 for comment. Specific procedures for testing qualifications are left to the discretion of the State.

Regarding furnace retrofit devices, DOE determined that some background in combustion heating systems, in electricity, in codes and regulations and in practical application is necessary to ensure a safe and effective installation.

Regarding installation of wind energy devices, DOE determined that some background in national and local codes and standards, and practical application is essential for an effective installation.

DOE considered three basic factors when developing the requirements for wind energy inspectors. First, the mechanisms whereby States operate quality assurance programs for other building systems vary considerably. DOE has attempted not to impose prescriptive requirements in an area which could lead to disruption in an existing State program. Second, the requirements proposed here reflect DOE's conviction that strong and direct relationships will exist between wind system manufacturers and the installers of those systems. Logically, the relationships should ease the problem of tracing compliance with the proposed standard. Finally, substantial strengthening of the wind system standards would affect the requirements for installers and inspectors, and may serve to ease the requirements for post-installation inspection to a point of verifying documentation. Until issues pertaining to the proposed standards are resolved, it appears unreasonable to prescribe any further specificity regarding qualifications for wind energy system inspectors.

DOE will provide, as part of its Technical Assistance to the States, model qualification programs in the areas of furnace retrofit measures and wind energy devices.

During the comment period on the March 19, 1979, proposed rule, DOE received comments requesting qualification criteria for installers and inspectors of solar systems.

It was noted that many of the past problems of consumer inconvenience concerning solar systems have stemmed from inadequate installation.

DOE acknowledges that a number of poor or improper installations of active solar systems have occurred over the past several years. The quality of installations has been significantly improving. DOE is confident that specific vocational training for solar installers currently available through several avenues could support even further improvements in installation quality. Also, a number of publications are now available incorporating the experience gained during the Federal (i.e., DOE, HUD, NSF) demonstrations. DOE is aware that States employ a variety of approaches (including different institutional mechanisms) to ensure quality of other types of residential active solar system installations. However, DOE is proposing to require the States to provide training or testing of trained installers and inspectors in order to ensure that those installers and inspectors who participate in the RCS program take advantage of these new programs and information channels. See § 456.314(d).

III. Proposed Standards

A. Background

NECPA requires the Secretary to develop material and installation standards necessary to ensure the safety and effectiveness of the installed material. DOE proposes to include in the Renewable Resource Installation and Materials Standards, standards for thermosiphon hot water heaters, swimming pool heaters, and wind systems. DOE also proposes to include in the Energy Conservation Material Standards a standard for urea-formaldehyde (U–F) foam insulation, additional requirements for vent dampers and IID's and a requirement for pipe insulation, and in the Energy Conservation Installation Standards, loading requirements for loose fill thermal insulation, and installation practices for U–F foam, caulks and sealants, vent dampers for gas-fired systems, and IID's.

B. Thermosiphon Hot Water Heaters

At the time of publication of the March 19, 1979, Proposed Rule, DOE had not yet completed its determination of the need for standards to assure the safety and effectiveness of thermosiphon hot water heaters. DOE now concurs with the opinion of several commenters, including the National Bureau of Standards, that the provisions of the *HUD Intermediate Minimum Property Standards* should be adopted for thermosiphon systems installed within the RCS program. Several sections of the HUD standards are appropriate only to active solar systems, however, and are therefore excluded from thermosiphon systems standards.

C. Replacement Swimming Pool Heaters

In the March 19, 1979 Proposed Rule, DOE had reserved the section on standards for replacement solar swimming pool heaters, pending further research, and solicited comments to assist in this research.

Information provided to DOE during the public comment period shows that solar swimming pool heaters vary widely in their physical properties. Many installed systems are of simple, low technology construction and typically can be installed by the consumer. Neither information provided by the commenters, nor DOE's ongoing assessment of these low technology heaters, has demonstrated a need for standards to protect consumer health or safety or to assure general effectiveness of these pool heaters. Thus, no standards are proposed for this class of solar swimming pool heaters.

However, there is evidence that solar pool heaters employing flat plate collectors and utilizing a non-potable working fluid are high technology systems requiring some standard to insure safe and effective installation. Therefore, DOE now proposes that these systems be installed in conformance with the applicable provision of the HUD *Intermediate Minimum Property Standards*. It should be noted that DOE believes that these types of units represent a small portion of the current sales of solar pool heating systems. Also, these types of systems employ components very similar (often ordered from the same suppliers) to the components utilized in solar water heating units and active space heating systems (hydronic).

Therefore, DOE believes that the proposed standard would not impose and undue burden on a developing industry while ensuring safe and effective installations of solar swimming pool heaters.

D. Wind Systems

Small wind energy conversion systems (SWECS) can be cost-effective measures and therefore are appropriate for inclusion in the RCS Program.

DOE has determined that certain standards are required to ensure safe and effective operation of residential SWECS. However, due to the relatively limited experience of the SWECS industry, DOE must exercise caution and not at this time impose restrictive or costly standards which could significantly disrupt industry growth and competition. Therefore, the proposed rule includes general performance and safety standards and, where experience to date has indicated a need, sets out prescriptive standards.

DOE's approach is necessary because of a number of considerations. First, due to the scarcity of engineering data regarding failure of these devices (or their subsystems), DOE cannot state with confidence which portions of SWECS design require standards to ensure safe and effective system operation. Also, due to lack of experience in field operation of residential SWECS, siting requirements need to be established to minimize personal or property injury should a SWECS tower, mechanical component (such as rotor connections), or electrical component (such as controls or interface equipment) fail to meet design specifications.

To DOE's knowledge, consensus standards and model code proceedings have not been initiated for matters specifically related to these devices. DOE will rely upon adequate voluntary consensus standards where they exist. DOE intends to review appropriate consensus standards as they become available for incorporation into this Rule.

DOE presented preliminary standards concerning wind system location and design in the March 19, 1979 RCS Proposed Rule. (44 FR 16546) These preliminary standards were the subject of several comments which questioned such provisions as siting wind systems at least 1½ tower lengths from any property line or occupied structure, and the rated survival wind speed being greater than the highest wind recorded during the last three years at the nearest official weather station having such records. The commenters' opinions varied on the preliminary standards; some felt the provisions were too restrictive, while others felt the provisions to be insufficient to provide assurances of safety and effectiveness.

Partly as a result of comments and partly as a result of its own concern, DOE has prepared and is proposing for comment substantially revised material and installation standards for SEWECS. In preparing this proposed standard, DOE has attempted to incorporate a prudent estimate of provisions which

might be required for safe and effective operation of these devices. Due to the lack of consensus standards in this area, this proposed standard relies mainly on maufacturer testing and self-certification and requires the installer to follow instructions that are required to be supplied by the manufacturer and the utility company.

DOE encourages utilities, manufacturers, affected States, professional societies, test laboratories, and other interested parties to provide DOE with their recommendations as to how to improve the proposed standards published today. Issues pertaining to inclusion of SWECS in the RCS Program as Program measures in a specific locality have already been resolved in the adoption of the RCS Final Rule.

Although DOE actively solicits comments on any portion of the proposed SWECS standard, DOE specifically solicits comments in response to the following questions:

• What facilities and instrumentation are required to perform a meaningful performance test?

• What levels and source of instrument calibration (and traceability) should be specified for the performance testing?

• Are reasonable alternatives to permitting manufacturer certification available? In other areas of standards development, DOE has made known its preference for third party (free from conflict of interest) certification known.

• What is the best means to ensure compliance with the provisions of the proposed standard? DOE is searching for a reasonable enforcement method without imposing undue burdens upon utilities, States, or manufacturers.

• Are additional standards required to ensure safe and efficient operation of these devices? The standard proposed by DOE primarily relates to performance, safety and installation siting DOE is not yet certain that standards relating to operating mechanical portions of a SWECS are required. Constructive criticism with respect to the need for this potential requirement is specifically requested.

In making recommendations, commenters are requested to advise DOE as to the basis for their recommendation. The following questions may prove helpful in formulating recommendations:

• *What is the basis for the requirement?* For instance, is documentable evidence available as to the need for the proposed requirement? Is this requirement commonly applied to similar products or components? What evidence is available that, without the requirement, a safety hazard would exist that a failure would occur or that SWECS effectiveness would substantially decline?

• *How will the requirement effect competition?* For instance, are estimates of effects of the requirement upon product cost available? Are laboratory facilities available to perform any required testing? If so, what similar products or similar tests are performed? At what cost?

In the event that substantial modifications are required as a result of public comment, DOE intends to permit further review of such revision. On the other hand, DOE will consider an absence of meaningful constructive recommendations to mean an acceptance of the standards as proposed. In the unlikely event that DOE is unable to finalize adequate SWECS standards prior to submission of State Plans, DOE will remove SWECS from the list of Program measures.

E. Material Standard for Urea-Formaldehyde Foam Insulation

DOE determined that a material standard is necessary to ensure the general safety and effectiveness of urea-formaldehyde foamed-in-place (U–F foam) insulation in the RCS program. This determination is based upon complaints received by the U.S. Consumer Product Safety Commission (CPSC) and various State agencies involving the release of formaldehyde gas into homes that had been insulated with U–F foam. By October 1979, for instance, the CPSC had received documented health complaints from 485 homeowners. These included reports of eye irritation, respiratory problems, nausea, vomiting, allergic reactions and other symptoms. These symptoms were reported at various times after the foam had been installed.

The product correctly manufactured and installed can be an effective insulating material. However, inconsistencies in the manufacturing process can result in: excessive shrinkage, deterioration of the foamed-in-place materials and off-gassing of urea-formaldehyde vapors. These inconsistencies included:

• Excess formaldehyde content in resin and fresh foam, and

• Excessive catalyst in the foaming agent.

The overall effectiveness and acceptability of U–F foam are difficult to evaluate since the insulation per se does not exist as a shelf item. In contrast with other insulation products, this product is created by the installer at the job site by mixing appropriate amounts of urea-formaldehyde resin, detergent, and catalyst along with various hardeners and conditioners. At the present time, it is not possible to assure that this standard will provide an optimum insulation material. It will, however, in conjunction with the Installation Standard for U–F foam, ensure a greater level of safety and effectiveness than would be possible without the standards or with other existing standards.

The chemistry of U–F foam is complex, and present knowledge of the origin, mechanism and release of formaldehyde from foamed-in-place insulation is meager. Current research indicates that free and hydrolyzable formaldehyde emissions from foam insulation are dependent, in part, upon temperature and humidity. Formaldehyde emissions are identifiable from three sources: free formaldehyde present in the reaction mixture, para-formaldehyde and hydrolyzable formaldehyde. Research shows that increased temperature and humidity accelerate the rate of hydrolysis of U–F foam, resulting in deterioration of the product. High temperature and high humidity not only affect the rate of formaldehyde emission but also adversely affect the physical characteristics of the foam structure. At present there are no reliable predictors at to whether or not formaldehyde off-gassing problems will arise at a given installation. Effective ways of curbing hydrolysis of the foam product are merely speculative at the present time.

The standard proposed in § 456.810 is based upon the Canadian Standard 51–6P–24M. However, significant deviations were made from the Canadian standard in the areas of free formaldehyde content, equipment and installer certification.

DOE recognizes the dispute regarding the extent of the loss in insulating efficiency caused by foam shrinkage. Actual heat loss measurements and laboratory tests performed by both NBS and the Canadian government have shown reductions in thermal resistence of 40 and 50% after shrinkage of U–F foam insulation in wall cavities. In addition, DOE has recently opened 43 wall cavities of homes in Portland, Oregon which had been reinsulated with U–F foam. Results showed that the mean shrinkage was 10.5% from 32 homes while the mean width shrinkage from 41 homes was 8.1%. Experimental investigations conducted by Dynatech R/D Company show there is a "direct relationship between effective thermal performance and size of air gap of the order of 5% loss for each 1% of shrinkage. . . . The results confirm the validity of the NBS Derating Analysis for deriving effective resistance of

materials which shrink within a cavity." (See "The Effective Thermal Performance of an Insulated Standard Stud Wall Containing Air Gaps" by R. P. Tye, A. O. Desjarlais, J. G. Bourne, and S. C. Spinney.) This means that a reduction in the thermal performance of the insulated walls in the Portland Study may have ranged from approximately 40 to 50%. Based on these considerations, The DOE proposed material standard therefore requires a 40% derating of U–F foam effective R- value. DOE did consider, however, tempering this requirement somewhat.

DOE considered permitting a manufacturer who could satisfactorily demonstrate that the shrinkage of a particular product is significantly less than 7 to 10%, to compute the present reduction of the thermal resistivity as 5 times the average expected shrinkage. DOE does not want to unjustly penalize manufacturers who have been successful in reducing shrinkage. However, DOE's information shows that actual shrinkage is often considerably more than manufacturers claim. DOE therefore solicits comments on how workable this approach would be and specifically what might constitute a "satisfactory demonstration" of shrinkage.

DOE proposes a significant change from the Canadian Standard which will require a reduction of the free formaldehyde content in the resin from 1% to 0.5% and a limitation of free formaldehyde in the fresh foam to 0.3%. DOE anticipates that these new requirements will help to reduce the off-gassing effect of free formaldehyde. DOE solicits comments on this position.

Established criteria and test procedures are included for dry density (ASTM D–1622), and flammability (ASTM E–84). Other test requirements for wet density, free formaldehyde content, water absorption, thermal resistivity, setting time, corrosiveness, volume resistivity, water drainage, and shrinkage were taken from the Canadian Standard. Other characteristics of U–F foam which impact the safety and effectiveness of the installed material include: freeze/thaw resistance, friability, temperature and humidity resistance, cell consistency, cell size, decomposition temperature, and inhalation toxicity. Neither the test procedures nor the criteria, however, have yet been established for these characteristics. Unlike the Canadian Standard, DOE did not include a provision for fungi resistance because recent findings in Canada have indicated that the test method for determining the fungi resistance is unreliable. However, a new test procedure needs to be developed. Laboratory tests have indicated that when U–F foams are maintained under moist or humid conditions for extended periods of time, there is a possibility that fungal growth may occur on the cavity wood frame and on the foam itself. Buildings that are to be insulated with U–F foam should therefore be constructed in a manner that will permit the foam to dry in as short a time as possible. This is addressed in the Installation Standard.

Unfortunately the product created at the job site is not the material that is used to satisfy the proposed material standards. This, coupled with the observation that the majority of the tests and suggested values have not yet been established, means that DOE will continue to examine material properties, test procedures and the impact of the proposed standard. If and when additional test procedures are developed which DOE determines will ensure a greater level of safety and effectiveness, DOE will propose them for comment.

In addition to the requirements described above, DOE has also required U–F component manufacturers to recommend equipment and equipment maintenance to their contractors which meet the minimum criteria described in both the material standard in § 456.810 and the installation standard in § 456.909. DOE seeks comment on this additional requirement. DOE has included these minimum equipment requirements to prevent the following problems:

(1) Fluctuating flow ratios of resin and foaming agent solutions resulting in variable density, resin-rich foam or resin-deficient foam.

(2) Blockages of foam dispensation through the exit hose resulting in inconsistent quality foam.

(3) Clogging of supply tubes resulting in resin-rich or resin-deficient foams and variable density.

(4) Suction air leakages that result in resin-deficient or resin-rich foams and variable density foam.

(5) Inadequate air supply resulting in variable density foam.

(6) Use of holding tanks and equipment parts that are acid corrosive resulting in underacidified foam producing foams of heavy density and inconsistent quality.

(7) Lack of thermometers to monitor solution temperatures in hot and cold weather that could result in improperly formulated foam.

(8) Oil contamination that results in foam collapse.

(9) Improper equipment modification resulting in out-of-specification solution temperatures during installation in hot and cold weather.

In addition, DOE has required U–F foam component manufacturers to train and certify installers of their material. An installation instruction manual must be provided to all installers in the training program.

As part of the Technical Assistance package to the States, DOE is considering the development of a model Quality Verification Program which States may want to include in their programs. Although the verification program is not included in the Proposed Rule, it could be an effective complement to the material and installation standards. Comment is requested on the advantages of such a program and suggestions are requested for developing a workable approach.

Numerous comments were received on the proposed material standard for U–F foam published in the March 19, 1979 RCS proposed rule. Several commenters expressed concern that the standard be stringent enough to ensure safety and effectiveness. DOE has tried to do this by placing greater limitations on the free formaldehyde content in resin and fresh foam, by including equipment criteria, and by including a requirement for a manufacturer-sponsored training program.

Several commenters objected to the procedure contained in § 456.810(c)(1) for devaluation of the thermal resistivity of installed U–F foam. Some commenters objected to any attempt at devaluation and others suggested that the more lenient criteria contained in HUD Bulletin No. 74 be used.

Experience with U–F foam in Portland (as discussed above) as well as experimental testing on the reduction of thermal performance conducted by Dynatech, and heat loss measurements and laboratory tests conducted at NBS, have convinced DOE that devaluation of installed U–F foam is necessary. These experiences also indicate that reduction in thermal performance is closer to the 40% devaluation contained in the Canadian Standard than the 28% contained in HUD Bulletin No. 74. DOE has therefore decided to retain the Canadian procedure for thermal resistivity and devaluation.

One commenter suggested that the flame spread of U–F foam tested in accordance with ASTM E–84 should be 75, the same as with all foam plastic insulation. DOE agrees that the requirements should be the same and has included a provision requiring a flame spread of 75 in the Proposed Rule.

One commenter expressed concern that any warning statement on U–F foam material containers would not be seen by the homeowner. DOE has therefore required that a cautionary statement be placed on material containers and presented separately to homeowners prior to installation of U–F foam insulation. The statement reads:

CAUTION: Under some conditions urea-formaldehyde insulation may cause the release of formaldehyde gas into living areas, and the development of adverse health effects. Continued exposure to formaldehyde can cause nausea and vomiting, respiratory difficulties, headaches, eye irritation, and allergic reactions. Such symptoms may develop anywhere from a few days to more than six months after the gas is released.

One commenter suggested the use of the test procedure for corrosion contained in the proposed ASTM standard rather than the procedure contained in the Canadian Standard. DOE did not agree with this suggestion since there is not enough data on the proposed test procedure. DOE is continuing, however, to evaluate the two test methods.

One commenter expressed concern over the allowable percentage of free formaldehyde content in the resin. DOE's research conducted at the University of Iowa suggests that the higher the free formaldehyde content in the foam components, the more likely off-gassing problems are after installation. Although the Canadian standard limits free formaldehyde in the resin to 1%, several major manufacturers claim that 0.3% is obtainable. DOE's studies indicate that reducing the free formaldehyde content to 0.5% will reduce the likehood of off-gassing problems while still providing manufacturers a reasonable opportunity to meet the requirement. Therefore, the Proposed Standard limits free formaldehyde in the resin to 0.5%. In addition, the proposed standard limits the formaldehyde content of fresh foam to 0.3% to further ensure safety since the bulk content must be less than the resin alone.

Several commenters suggested that manufacturers be required to conduct all tests at the same time on the same batch of material. DOE agrees that this suggestion is necessary to ensure accurate, meaningful test results and has included it in the Proposed Rule.

The National Association of Urea Foam Insulation Manufacturers (NAUFIM) submitted detailed comments on equipment criteria, installer certification, and installation procedures. Based on recommendations by NAUFIM, DOE included in the material standard specific requirements for equipment and installer certification which should contribute significantly to ensuring a safe and effective installation.

One commenter suggested that all test requirements be verified by an independent laboratory. DOE gave considerable attention to this suggestion and determined not to require independent testing unless need for such a quality control procedure becomes apparent.

DOE readily acknowledges that there are still many unanswered questions relating to the causes of off-gassing, deterioration of installed U–F foam, nad shrinkage. Information is solicited on the following questions:

(a) What is the incidence of odor complaints and/or health-related problems compared to total U–F foam installations?

(b) Has an attempt been made to diagnose the cause of the complaints? Do the standards proposed here address those causes?

(c) To what extent does the formaldehyde content in U–F foam components influence the potential for off-gassing?

In addition, serious questions have been raised by the CPSC and others concerning safety problems associated with the off-gassing of formaldehyde from U–F foam insulation. Consequently, in assessing the record of the rulemaking and considering whether to issue a final standard for U–F foam, DOE will focus on the following questions:

(a) Whether the standards will adequately address the problems associated with the off-gassing of formaldehyde from U–F foam insulation;

(b) Whether the standards will be effective in confining the off-gassing of formaldehyde to a tolerable level, if such a level exists, and

(c) Whether the standards are practical, are capable of being followed, and are likely to be followed by installers in practice.

The answers to these questions will largely determine whether DOE will issue final standards for U–F foam insulation or will exclude U–F foam from the RCS program. Unless DOE can conclude that, based upon all available data, the proposed standard or some slight modification to it will assure general safety and effectiveness, DOE will exclude U–F foam from the RCS Program.

F. Material Standards for Pipe Insulation

DOE determined in the final rule that standards were necessary for all other insulation materials. Because the potential for insulation-related problems exists for pipe insulation as well as other insulating materials, DOE is proposing a material standard for pipe insulation. A flame spread rating on the exterior surface of 25 is proposed to ensure consistency with NFPA 90. DOE solicits comments on whether a material standard for pipe insulation is necessary to ensure the safety and effectiveness of materials installed under the RCS program.

G. Additional Requirements for Vent Dampers and IID's

Not all vent dampers and IID's can be safely installed on all existing heating systems. Considerable differences exist in appliance controls and control equipment, such as 2, 3, or 4 wire thermostats, circulators, zone controls, tankless coils, boilers with relays, etc. found on units in the field. DOE has determined that installers need some guidance in determining which vent damper and IID's are compatible with which appliances. DOE has therefore required vent damper and IID manufacturers to provide to their installers wiring schematics of those furnace controls panels with which their unit is compatible. We estimate that approximately five wiring schematics would cover 80 to 90% of the furnance controls found in the field today. DOE is aware of the concern expressed by manufacturers over this requirement and solicits comments.

H. Loading Requirements for Installation of Loose Fill Thermal Insulation

Maximum allowable loads are now being proposed for all types of loose fill insulation when installed on attic floors. The proposed rule for the RCS program issued March 19, 1979 included a maximum loading chart only for the installation of vermiculite and perlite insulation on attic floors. In the RCS Final Rule, issued November 7, 1979, the installation standards for all types of loose fill insulation were combined, and a provision for loading was reserved. Loading requirements are proposed here in order to provide an opportunity for comment. The maximum suggested loads are the same as those originally proposed except that they apply to all types of loose fill insulation. They are recommended by various gypsum board manufacturers and the U.S. Gypsum Association. Comments on the March 19 Proposed Rule stated that these values were far too conservative. DOE, however, has no source of information other than gypsum board manufacturers from which to obtain load recommendations, and DOE therefore

solicits comments and test data which would support or contradict the recommendations.

I. Installation Standards for Urea-Formaldehyde Foam Insulation

The Department of Energy has investigated urea-formaldehyde (U–F) foamed-in-place insulation and has identified a substantial number of incidents involving the release of formaldehyde gas into homes that had been insulated with U–F foam. The complaints accompanying these incidents included reports of eye irritation, respiratory problems, nausea, vomiting, allergic reaction, and other symptoms. The Department of Energy has therefore concluded that an installation standard for this material is essential to ensure its safe and effective installation. The proposed standard contained herein initiates this effort by DOE. Interested persons are invited to comment on this standard during the comment period.

DOE recognizes that the promulgation of an installation standard alone cannot ensure compliance and thus a safe and effective installation. Reliance on the quality of U–F foam is highly dependent upon manufacturing process control, qualification of the equipment used, and qualification of the personnel controlling the process. Because U–F foam is manufactured on-site rather than in the factory, DOE has redefined the manufacturer and installer for this section. The "component-material supplier" is the supplier of the resin, foaming agent, and other ingredients to the foam insulation manufacturer. The component-material supplier is responsible for these component materials in all operations up to and including delivery to the insulation manufacturer. The "insulation manufacturer" means the installer who combines these component materials and foams the insulation in place. At a minimum, the insulation manufacturer must pay strict attention to the following to assure adequate quality of the installed product:

- The use of properly aged resin.
- The use of compatible components and proper ratios of each.
- Verification that the temperature of ingredients, mixtures and equipment is under control at all times.
- Assurance that the hose lines are transporting the material as intended.
- Assurance that gun apertures and/or mixing chambers are not faulty or dirty when used.
- Assurance that the premises to be insulated have been properly inspected.
- Assurance that the construction of a particular wall cavity will allow the proper curing of U–F foam.

The standard is not intended to detail specific installation techniques or procedures, but to set forth minimum criteria for a safe and effective application. For instance, although interior fire protective coverings and vapor barriers may be required, details relating to the installation are not included.

DOE does not permit the application of U–F foam in ceilings in the RCS Program. This determination is based on three characteristics of the material:

First, U–F foam has been shown to deteriorate under high temperatures and humidity, conditions frequently found in attics. Secondly, formaldehyde gas is denser than air and any gas liberated by the form may invade the living space below and pose a health hazard to the occupants. Third, when applied, the product contains much moisture which also increases its weight considerably. This combination of moisture and weight on the ceiling surface may result in damage to the ceiling.

DOE requires on all installations in Zone 1 of Figure 1 in § 456.905 that a proper barrier be provided on the interior surface of all walls being insulated in bathrooms and unvented kitchen and laundry areas and that all major cracks on the interior walls be caulked or sealed. The standard also requires the installer to determine if an impermeable vapor barrier exists on the outside of the wall and, if so, to eliminate the barrier. These requirements are included to ensure that the wall permits the venting of formaldehyde vapors to the outside during the curing process.

Even though U–F foam installation standards have not been proposed heretofore, the following comments were received: One commenter recommended including shredded, cured U–F foam as a type of attic insulation. The commenter claimed the product could be pneumatically blown like other loose fill materials. DOE rejected the suggestion since the concept is realtively new and DOE has not had the opportunity to properly evaluate it and observe its characteristics in field installations. DOE may consider this application at a later time.

Several commenters objected to provisions in other installation standards prohibition additional wall insulation, claiming that the addition of U–F foam in an insulated wall cavity could result in additional energy savings. DOE still maintains that, given today's fuel costs, a homeowner is unlikely to recover the cost of adding U–F foam to an already—insulated cavity except in the coldest regions of the country—and only then if minimal insulation is present and if the cost per square foot of material installed is relatively inexpensive. In addition, depending upon the kind of existing insulation and the wall construction, moisture-related complications might occur when liquid components of U–F foam insulation are added. However, DOE has determined that since the issue is largely an economical one, it should be handled through the audit procedure. (See § 456.307 of the Final Rule (44 FR 64668).) No reference is therefore made in the Installation Standard to installing additional wall insulation.

J. Installation Standards For Vent Dampers on Gas-Fired Systems

Automatic vent dampers can be potentially dangerous if they are not installed properly. Vent dampers are intended to shut off the air flow up the vent during periods when the burner is not firing, thereby saving the loss of conditioned air. However, during periods when the burner is firing, the damper must be open to allow hazardous combustion products to be vented outside of the residence. If improperly installed, the vent damper could shut off the vent during burner firing, and cause hazardous combustion products to be vented into the residence with possible fatal results.

Some vent dampers are designed to be retrofitted to some existing heating appliances. These heating applicances may include a large number of models which may be installed differently in each residence. The vent system, combustion air supply, and heated air system may also vary. The capability and experience of the installers may vary.

Recently, the American National Standards Institute promulgated material standards ANSI Z21.66–1977, ANSI Z21.67–1978 and ANSI Z21.68–1978 for vent dampers for use with gas-fired appliances with accompanying installation guidelines. Because of variances in field conditions, DOE was concerned that these installation guidelines did not adequately ensure a safe and effective installation. DOE was concerned that these guidelines did not sufficiently address the intended use of these devices and their compatibility with other systems.

In drafting the Installation Practices for vent dampers, DOE has required practices that go beyond those stated in the ANSI guidelines. Although the Installation Practices may impose additional burdens on installers, they were included to ensure the general

safety and effectiveness of vent damper installations. DOE solicits comments to further improve the workability and safety and effectiveness of the proposed Installation Practices.

The Installation Practices for vent dampers are confined to field installations on forced-air and gravity gas furnances and low-pressure hot water gas boilers. DOE has excluded the installation of vent dampers on oil-fired furnances temporarily from the RCS Program until studies presently underway are complete. Brookhaven National Laboratory has conducted tests which question the effectiveness of such installations on oil-fired units equipped with high efficiency burners. DOE will further investigate this type of installation. DOE in the meantime is soliciting comments on this matter. Vent damper installations on water heaters are excluded because they are beyond the scope of the program. Furthermore, such installations often do not prove cost-effective. Installations on steam boilers were not included because of the relatively minor residential market they encompass. Liquid petroleum gas (LPG) systems were excluded because of the additional safety problems associated with such systems. LPG is heavier than air, and thus there exists the possibility of gases collecting around furnances and creating a hazardous condition. DOE will look further into installation for other types of systems.

Because vent capacities are reduced when the difference between indoor and outdoor temperatures is the least and generally when wind velocities are low, DOE has required that all checks of venting capacity or draft hood spillage be conducted when the outside temperature is above 65° F and the wind velocity is less than 10 MPH. DOE has concluded that checks at any less severe conditions may not indicate the possibility of spillage of hazardous exhaust products. No other satisfactory, proven, technique is known for conducting draft checks. DOE solicits comments on how more flexibility may be added to this procedure. DOE will take the results of research in this matter into account in the Final Rule.

The Installation Practices limit the use of vent dampers to heating systems in heated spaces.

Vent dampers save energy by reducing heated air flow up the vent during periods when the main burner of the heating appliance is off. Most of the heated air is retained in the area adjacent to the heating appliance. If that area is not serviced by the heating system, the vent damper will result in minimal savings and is unlikely to be cost-effective.

The proposed installation standards permit only those installations where the wiring diagrams supplied by the vent damper manufacturer show the vent damper to be compatible with the existing heating system. DOE wants to insure that the maximum possible safety is achieved in every vent damper installation. Because of differences in appliance controls and control equipment, such as 2, 3, or 4 wire thermostats, circulators, zone controls, tankless coils, boilers with relays, etc. found on units in the field, DOE feels this is an important provision. DOE is aware of the concern over this requirement and solicits comments.

Vent dampers are currently being installed with a redundant gas valve or damper-closing temperature control. Dampers with closing temperature controls in lieu of two gas valves are required by ANSI to have at least a 10 percent open area in the nominally closed position. The damper-closing temperature control is designed to allow the vent damper to remain open when the vent gas temperature is above 225°F when tested under specified conditions. This is to keep the damper open if there is a malfunction of the automatic gas valve such that gas flows without a call for heat. A malfunction of the automatic gas valve can allow a flow of gas between zero and full flow. Although the NASI installation guidelines do not provide for a test of the damper-closing temperature control, this proposed standard does. It has been determined by DOE that a vent gas temperature of 375°F measured at full gas flow will provide a vent gas temperature of at least 225°F for the majority of hazardous leaking valve conditions. If this temperature at full gas flow is not above 375°F, DOE has required that a vent damper not be installed with a damper-closing temperature control.

DOE has required the addition of a second automatic gas valve on all Thermally-Actuated Vent Dampers. The vent damper material standards require that thermally-actuated vent dampers pass a flow restriction test only at a vent gas temperature of 370°F. Even though the vent gas temperature at full gas flow may be above 370°F, the vent gas temperature at partial gas flow through a malfunctioning gas valve may be less than 370°F. On units currently being manufactured, the amount of opening may not be proportional (i.e., nonlinear) to the vent gas temperature. It is conceivable that a unit could be manufactured which would snap open at a vent gas temperature of only slightly less than 370°F. A reduced gas input could result in vent gas temperatures that were insufficient to properly open the vent damper. The consequences of such a failure would be hazardous and perhaps fatal. Therefore, DOE has required a redundant gas valve on all thermally-actuated vent damper installations.

Although DOE anticipates some controversy over these requirements, there is a definite need to insure that the maximum safety and effectiveness of vent damper installations are maintained. DOE solicits comments on how flexibility may be built into these provisions, yet still assure the same measure of safety.

The installation standards require an installer to shut off the gas to the appliance prior to installation. DOE considered incorporating a similar requirement to shut off electrical power. This was not included since the installer may be checking for voltage. DOE is concerned, however, that when the installer is checking for loose electrical connections, worn electrical insulation, etc., that a hazardous situation may result. Comments are requested on the importance of turning off electrical power prior to the installation.

DOE is concerned about the safety and effectiveness of vent dampers on water heater/furnace installations using the same vent and combustion air. The American Gas Association's 1977–1978 report on the Space Heating System Efficiency Improvement Program (SHEIP) questions the effectiveness of vent dampers in this situation. DOE would like further comments on this matter.

In addition to comments requested above, DOE would also like to receive comments concerning the following:

- Should vent dampers be allowed when installed in unheated areas if combustion air is taken from a heated space?
- Should the vent damper standards require stricter control on vent damper closing times?
- Since vents tend to settle after numerous off-on cycles, should there be a requirement that the vent damper be inspected during the heating season? Should there be additional inspections after the initial post-installation inspection?

Unless DOE can conclude that, based on upon all available data, the proposed standard or some modification to it will assure general safety and effectiveness, DOE will exclude vent dampers from the RCS program.

K. Installation Standard For Automatic Intermittent Pilot Ignition Devices (IID's)

As part of these proposed rules, DOE is publishing Installation Practices for IID's. DOE is proposing the proposed draft ANSI installation standard. The standard is entitled "Proposed American National Standard for Automatic Intermittent Pilot Ignition Systems for Field Installation." A copy may be obtained by contacting:

Mr. F. G. Hammaker, Administrative Secretary, Z21 American Materials Standards Committee, 8501 E. Pleasant Valley Road, Cleveland, Ohio 44131, (216) 524–4990.

The standard is designed to adapt automatic intermittent ignition systems to existing pilot burners on listed forced air heating appliances and boilers equipped with atmospheric burners. DOE has some concern with the use of the proposed ANSI standard for this proposed regulation. There is no limitation on the voltage or current between the electrodes in the ANSI hardware standard Z21.20—1979 which could result in a startle shock or a lethal hazard. DOE would like to receive further comment on this item. The proposed standard also limits the IID only to ignition systems with recycling pilots. DOE also solicits comments on this constraint.

Unless DOE can conclude that, based upon all available data, the proposed standard or some modification to it will assure general safety and effectiveness, DOE will exclude IID's from the RCS Program.

L. Installation Standards For Caulks And Sealants

DOE is proposing an Installation Standard for caulks and sealants to ensure the effectiveness of the installed material. Comments are solicited on the advantages and disadvantages of including an installation standard for caulks and sealants in the RCS program.

Improper installation of caulks and sealants can contribute to moisture condensation and accumulation of moisture within building elements which can lead to various forms of deterioration such as fungus growth in wood structures, and corrosion of metal fasteners, pipes, and electrical service components. Moisture can also reduce the effectiveness of insulation and with some insulation materials can also cause the leaching of fire retardants and thus contribute to increased fire hazards. In addition, if specific caulks and sealants are used in an application which is not suitable for the material or with existing building materials which are not greatly reduced. Reduced effectiveness will also occur if the area of application is not properly prepared. These areas are addressed in the proposed Installation Standard for Caulks and Sealants.

There is little information available on the quality of contractor-installed caulking. The Tennessee Valley Authority, however, included caulking and weatherstripping in its home weatherization program in November 1978. Since that time they have recalled contractors about 35 percent of the time to correct poor workmanship on caulking and weatherstripping installations.

M. Vent Dampers on Oil-Fired Systems

DOE considered inclusion of UL 17 "Standard for Vent or Chimney Connector Dampers for Oil-Fired Appliances" but determined that the standard was not complete enough to ensure a safe and effective installation. UL 17 is used to check instructions for installation rather than to actually install a vent damper. DOE maintains that the hazards associated with improper installations are sufficient to warrant specific installation criteria. Because they do not now exist, vent dampers for oil-fired furnaces are not currently included in the RCS program. DOE will continue to work on the development of an installation standard for vent dampers on oil-fired systems and will propose it for comment at a later date.

IV. Regulatory Analysis and Urban Impact Assessment

The President, by Executive Order 12044, has directed agencies of the Executive Branch to conduct a Regulatory Analysis of regulations which they prepare that are likely to have a major economic impact. In accordance with OMB Circular A–116, an Urban and Community Impact Assessment should be prepared when the proposed rule is a major policy and program initiative. This assessment should be incorporated into the Regulatory Analysis.

DOE determined that the Residential Conservation Service Program, authorized under Title II, Part 1 of the National Energy Conservation Policy Act, was a major action and required preparation of a Regulatory Analysis and an Urban and Community Impact Assessment. Consequently, the Department prepared the two analyses in draft in conjunction with the publication of the Proposed Rule for the RCS Program on March 19, 1979 (44 FR 16546). These analyses were finalized for publication in conjunction with the Final Rule which was published November 7, 1979 (44 FR 64602). The final Regulatory Analysis, which incorporates the final Urban and Community Impact Assessment, includes analysis of this proposed rule. Although this proposed rule does not in itself constitute a major action, DOE believes that an analysis of its impacts should be incorporated into the Final Regulatory Analysis so that that document reflects the entire impact of the RCS Program.

A single copy of the Final Regulatory Analysis may be obtained by writing:

Mr. James R. Tanck, Director, Residential Conservation Service Program, Office of Assistant Secretary for Conservation and Solar Energy, U.S. Department of Energy, 20 Massachusetts Avenue, N.W., Washington, D.C. 20585.

V. Environmental Impact Statement

In accordance with the requirements of the National Environmental Policy Act of 1969 (NEPA), 42 U.S.C. 4321 *et seq.*, DOE prepared an Environmental Impact Statement for the entire Residential Conservation Service Program. The subject matter of this rulemaking was evaluated in the programmatic Environmental Impact Statement. A notice of availability of the Final Environmental Impact Statement was published in the **Federal Register** on November 7, 1979 (44 FR 64602). A copy of the final Environmental Impact Statement may be obtained by writing:

Mr. James R. Tanck. Director, Residential Conservation Service Program Office of Assistant Secretary for Conservation and Solar Energy, U.S. Department of Energy, 20 Massachusetts Avenue, NW., Washington, D.C. 20585.

VI. Consultation With Other Federal Agencies

In preparing this Proposed Rule, issues and options were reviewed by representatives of the National Bureau of Standards and the Consumer Product Safety Commission.

VII. Contractor Contributions To The Rulemaking

The following entities have made contributions to this proposed rulemaking:

1. The National Bureau of Standards assisted in the development of the proposed material and installation standards for conservation measures.

2. The Solar Energy Research Institute (SERI); Rocky Flats Plant of North American Rockwell; and Science Applications, Inc. (SAI) assisted in the development of the proposed standard for wind energy systems. SERI and SAI also assisted in the development of the

thermosiphon hot water heaters and solar swimming pool heaters proposed standards.

3. Calspan, Inc., and Hittman Associates, Inc., assisted in the development of the proposed installation standards for vent dampers and automatic ignition systems and the proposed modification to the material standards for vent dampers.

VIII. Comment And Hearing Procedures

A. Written Comments

Interested persons are invited to participate in this rulemaking by submitting data, views, or arguments with respect to the proposed procedures, requirements, and criteria. Comments should be submitted to the address indicated in the addresses section of this preamble and should be identified on the envelope and on the documents submitted to DOE with the designation "Residential Conservation Service Program, (Docket No. CAS–RM–79–101)." Fifteen copies should be submitted. All written comments must be received by February 19, 1980, 4:30 p.m., e.s.t., to ensure consideration.

All written comments received on the Proposed Rule will be available for public inspection in the DOE Reading Room, Room GA–152, Forrestal Building, 1000 Independence Avenue, S.W., Washington, D.C., between the hours of 8:00 a.m., and 4:30 p.m., Monday through Friday. Any information of data considered by the person furnishing it to be confidential must be so identified and one copy submitted in writing. DOE reserves the right to determine the confidential status of the information of data and treat it according to its determination.

B. Hearing Procedures

The time and place of the public hearing is indicated in the hearing section of this preamble. DOE invites any person who has an interest in the proposed rulemaking or who is a representative of a group or class of persons that has an interest in the proposed rulemaking, to make a written request for an opportunity to make an oral presentation. Such a request should be directed to the address indicated in the addresses section of this preamble and must be received before 4:30 p.m. on January 7, 1980.

Such a request may be hand delivered to Room 2221C, 20 Massachusetts Avenue, N.W., between the hours of 8:00 a.m. and 4:30 p.m., Monday through Friday. A request should be labeled both on the document and on the envelope "Residential Conservation Service Program."

The person making the request should briefly describe the interest concerned; if appropriate, state why she or he is a proper representative of a group or class of persons that has an interest; give a concise summary of the proposed oral presentation; and provide a telephone number where he or she may be contacted through the day of the hearing.

Each person who, in DOE's judgement, proposes to present relevant material and information shall be selected to be heard and shall be notified by DOE of his or her participation before 4:30 p.m. on January 14, 1980.

Persons selected to appear at the hearing should submit 15 copies of his or her statement by 4:30 p.m. on January 17, 1980 to:

Joanne Bakos, Office of Conservation and Solar Energy, Department of Energy, Mail Stop 2221C, 20 Massachusetts Avenue, NW., Washington, D.C. 20585.

The hearing will begin at 9:00 a.m., e.s.t. on January 21, 1980, at Room 3000A, 12th and Pennsylvania Avenues, NW., Washington, D.C.

C. Conduct of Hearing

DOE reserves the right to arrange the schedule of presentations to be heard and to establish the procedures governing the conduct of the hearing. The length of each presentation may be limited, based on the number of persons requesting to be heard. A DOE official will be designated as presiding officer to chair the hearing. Questions may be asked only by those conducting the hearing, and there will be no cross-examination of persons presenting statements.

Any participant who wishes to ask a question at the hearing may submit the question, in writing, to the presiding officer. The presiding officer will determine whether the question is relevant and material, and whether the time limitations permit it to be presented for answer.

Any further procedural rules needed for the proper conduct of the hearing will be announced by the presiding officer.

A transcript of the hearing will be made and the entire record of the hearing, including the transcript, will be retained by DOE and made available for inspection at the DOE Freedom of Information Reading Room, Room GA–152, Forrestal Building, 1000 Independence Avenue, S.W., Washington, D.C. 20585, between the hours of 8:00 a.m., and 4:30 p.m., Monday through Friday. Any person may purchase a copy of the transcript from the reporter.

In consideration of the foregoing, the Department of Energy proposes to amend Chapter II, Title 10 of Part 456 of the Code of Federal Regulations, as set forth below.

Issued in Washington, D.C., on December 13, 1979.

Maxine Savitz,

Acting Assistant Secretary, Conservation and Solar Energy.

1. 10 CFR Part 456 is amended by revising § 456.814(f) and adding §§ 456.314(b), (c) and (d); 456.703; 456.704; 456.705; 456.810; 456.812(e); 456.814(g)(3); 456.905(d)(1)(ii); 456.909; 456.914; 456.915; and 456.916.

2. The table of content is amended by adding the following entries.

* * * * *

Sec.

456.703 Thermosiphon hot water heaters.
456.704 Swimming pool heaters.
456.705 Wind energy devices.
* * * * *
456.810 Standard for urea-formaldehyde foamed-in-place insulation.
* * * * *
456.812 Standards for caulks and sealants, water heater insulation, heating/air conditioning duct insulation and pipe insulation.
* * * * *
456.909 Standard practice for the installation of urea-formaldehyde foamed-in-place insulation.
* * * * *
456.914 Standard practice for the installation of electrically-operated, mechanically-actuated, and thermally-actuated automatic vent dampers for use with gas-fired central furnaces and low-pressure hot-water boilers.
456.915 Standard practices for the installation of automatic intermittent pilot ignition devices (IID's).
456.916 Standard practices for the installation of caulks and sealants.

Authority: Part 1 of Title II of the National Energy Conservation Policy Act, Pub. L. No. 95–619, 92 Stat. 3206, *et seq.;* Department of Energy Organization Act, Pub. L. No. 95–91, 91 Stat. 565, *et seq.*, 42 U.S.C. 7101, *et seq.*

§ 456.314 Qualification procedures for auditors, installers, and inspectors.

* * * * *

(b) *Installers and inspectors of automatic vent dampers and automatic intermittent pilot ignition devices (IID's) for gas-fired central furnaces and low-pressure hot water boilers.* The State Plan shall contain procedures to assure that any person or persons installing automatic vent dampers or automatic intermittent pilot ignition devices (IID's) for gas-fired central furnaces and low-pressure hot water boilers under the

circumstances described in the State Plan pursuant to § 456.305 and any person or persons conducting a post installation inspection of an automatic vent damper or IID pursuant to § 456.313(a) shall have the following qualifications:

(1) Installers' inspectors shall demonstrate an understanding of applicable codes and regulations.

(2) Installers and inspectors shall demonstrate an understanding of gas appliances used in residential buildings, including basic system requirements, components and operation, and shall demonstrate an understanding of general schematics and potential malfunctions of gas appliances.

(3) Installers and inspectors shall demonstrate an understanding of gas appliance controls and safety controls, including automatic gas valves, limit switches, and thermostats. Installers and inspectors shall also demonstrate an understanding of basic furnace and boiler circuitry, including electrical components, and the use of appropriate meters for testing gas appliance circuitry. They shall also demonstrate an understanding of proper component sequencing and be qualified to determine the compatibility of vent dampers and appliances.

(4) Installers and inspectors shall demonstrate an understanding of the purpose, general structure, and operational systems of vent dampers. They shall also demonstrate an ability to service and install electrical, mechanical, and thermal vent dampers and shall be familiar with the advantages and disadvantages of each type. *Exception.* Installers and inspectors of only IID's need not comply with this paragraph.

(5) Installers and inspectors shall demonstrate an understanding of the purpose, basic system requirements and components, and operation of IID's. In addition, they shall demonstrate practical application in servicing and installing IID's, and understanding of general schematics and potential malfunctions of IID's. *Exception.* Installers and inspectors of only vent dampers need not comply with this section.

(6) Installers and inspectors shall demonstrate: (i) an understanding of types of vents, draft diverters, and heat transfer components; (ii) an understanding of venting theory including ventilation air, dilution air, and vent sizing; (iii) an understanding of venting installation procedures; (iv) knowledge of which installations are prohibited; (v) that they are qualified to perform leak and spillage checks; and (vi) that they are qualified to use instrumentation to measure carbon monoxide and carbon dioxide emissions from gas appliances.

(7) Installers and inspectors shall demonstrate an understanding of proper combustion and proper flame characteristics and shall be familiar with gas piping procedures.

(8) Installers and inspectors of vent dampers shall demonstrate an understanding of the installation standards in § 456.914.

(9) Installers and inspectors of IID's shall demonstrate an understanding of the installation standards in § 456.915.

(c) *Installers and inspectors of wind energy devices.* (1) The State Plan shall contain procedures to assure that any person or persons installing a wind energy device under the circumstances described in the State Plan pursuant to § 456.305 and any person or persons conducting a post-installation inspection of a wind energy device pursuant to § 456.313(a) shall have the following qualifications:

(i) Familiarity with the installation standards for wind energy devices in Subpart G;

(ii) Familiarity with the structural characteristics of wind energy devices;

(iii) Familiarity with national and local codes governing the electrical interface between the wind energy device and the utility power supply for the residence; and

(iv) A general knowledge of the test procedures described in § 456.705.

(2) The State Plan shall contain procedures to assure that any person or persons installing a wind energy device under the circumstances described in the State Plan pursuant to § 456.305 shall demonstrate proficiency in the installation of wind energy devices, and familiarity with the testing of wind energy devices in accordance with the procedures described in § 456.705.

(d) *Installers and inspectors of solar domestic hot water systems, active solar space heating systems, and combined active solar space heating and solar domestic hot water systems.* (1) The State Plan shall contain procedures to assure that any person or persons installing a solar domestic hot water system, an active solar space heating system, or a combination thereof, under the circumstances described in the State Plan pursuant to § 456.305, and any person inspecting such systems pursuant to § 456.313(a), shall individually or collectively be knowledgeable about:

(i) The residential construction methods employed in the region and the characteristics of structures that would preclude a safe and enduring solar installation;

(ii) The applicable provisions of the *HUD Intermediate Minimum Property Standards Supplement,* as required in Subpart G;

(iii) The design, operation, installation and degradation of residential hot water and heating systems with which the solar devices will interface; and

(iv) The connection of the solar devices into the existing residential systems, including testing for satisfactory performance of the solar devices and the modified system, according to the requirements of the *HUD Intermediate Minimum Property Standards Supplement* as required for the program in Subpart G.

(2) The State Plan shall contain procedures to assure that any person or persons installing a solar domestic hot water system, an active solar space heating system, or a combination thereof under the circumstances described in State Plan pursuant to § 456.305 shall demonstrate proficiency in the connection of the solar devices into existing residential systems, in conformance with the applicable provisions of the *HUD Intermediate Minimum property Standards Supplement,* as required for the program in Subpart G.

§ 456.703 Thermosiphon hot water heaters.

Thermosiphon Hot Water Heaters shall be constructed and installed in compliance with the applicable provisions of the *HUD Intermediate Minimum Property Standards Supplement,* Solar Heating and Domestic Hot Water Systems, 4930.2. 1977 Edition, with the exception of several specific provisions that are inappropriate to this technology. The excluded sections are 5–615–1.4.2. and Appendix A, which present procedures for calculating active solar domestic hot water system performance.

§ 456.704 Swimming pool heaters.

Solar swimming pool heaters employing glazed flat plate collectors or a non-potable heat transfer fluid to capture and transfer solar energy to the pool water, shall be constructed and installed in compliance with the applicable provision of the *HUD Intermediate Minimum Property Standards Supplement,* Solar Heating and Domestic Hot Water Systems, 4930.2, 1977 Edition. Solar swimmining pool heater systems employing non-glazed collectors and the direct heating of recirculated pool water are exempt from these standards.

§ 456.705 Wind energy devices.

(a) *Scope.* This standard established the requirement for wind energy devices installed or supplied under the RCS program. Only electrical wind energy devices that are interconnected to a utility company's electrical system, known as Small Wind Energy Conversion System (SWECS), that meet the standards of this section may be installed or supplied under the RCS program.

(b) *Definitions.* For purposes of this Subpart:

(1) The term "anemometer" means a device to measure wind speed.

(2) The term "anemometer distance constant" means a measure of the frequency response characteristics of an anemometer; the length of wind run that must pass an anemometer before it indicates 63 percent of the actual amplitude of a step-change gust.

(3) The term "atmospheric test" means the conduct of SWECS testing under natural wind conditions.

(4) The term "bin width" means the size of the wind speed interval (meters per second) used in the method-of-bins.

(5) The term "cylinder of projection of SWECS rotor" means the cylinder whose axis is aligned with the wind direction and passes through the center of the rotor, whose cross-section extends 3 rotor diameters upwind of the rotor and 6 rotor diameters downwind of the rotor.

(6) The term "disconnect" means a device or group of devices or other means by which the conductors of an electrical circuit can be disconnected from their source of supply.

(7) The term "electrical ground" means a conducting connection between an electrical circuit and/or equipment and the earth, or to some conducting body that serves in place of the earth.

(8) The term "electrical load" means an electrical device which utilizes electrical energy.

(9) The term "electrical utility/user interconnection" means physical connection of the electrical hardware of the SWECS to the electrical system of both the utility and the user.

(10) The term "free stream area" means that area in a wind tunnel test section in which the wind speed in the absence of an obstruction, is uniform within ±5 percent.

(11) The term "horizonal axis wind turbine" means a SWECS that has an axis of rotation of the rotor parallel to the plane of the ground.

(12) The term "interconnected SWECS" means a SWECS which is electrically connected to fuel power with the utility grid.

(13) The term "method-of-bins" means a computer data analysis technique as detailed by Akins in reference 1. The method consists of partitioning the wind speeds observed into a number of equally spaced intervals or bins. The average of all power values observed simultaneous with a wind in a given bin is the power associated with the wind speed at the center of the bin.

(14) The term "obstruction frontal area" means the projected area of an obstruction of the ambient wind.

(15) The term "power output curve" means a graphical plot of SWECS power output versus wind speed.

(16) The term "projected frontal area" means the profile area of an object as seen from the direction of the wind velocity.

(17) The term "Rayleigh distribution" means a wind speed distribution function represented by the following probability density equation

$$\text{Hours } (>V) = 8760 \exp. \left[-\frac{\pi}{4}\left(\frac{v^2}{\bar{v}}\right) \right]$$

Where hours:

(>V)=number of hours per year the wind speed exceeds a given wind speed V (meters per second)

V=wind speed (meters per second)

$\bar{V}$=annual gauge wind speed (meters per second)

(18) The term "rated power" means the power output obtained from a SWECS generating at its rated wind speed.

(19) The term "rated wind speed" means the wind speed at which the rated power is specified.

(20) The term "rotor" means a system of rotating elements that convert the energy in the wind into mechanical shaft power.

(21) The term "rotor-swept area" means the area as seen from the direction of the wind that a rotor would pass over during one revolution.

(22) The term "Small Wind Energy Conversion System (SWECS)" means an electrical wind energy device having a rated output of less than 100 kilowatts that is interconnected to a utility company's electrical system.

(23) The term "SWECS Model" means a specific hardware configuration established by the manufacturer for fabrication and sale ot the general public.

(24) The term "thrust" means the force exerted by the wind on the SWECS rotor in the direction of the ambient wind.

(25) The term "tower" means a subsystem of a SWECS that holds the rotor or other collection device above the ground.

(26) The term "towing test" means the conduct of SWECS testing where the SWECS is mounted on a vehicle (such as a truck or train flat car) and the SWECS is moved through still ambient air.

(27) The term "turbulence" means rapid fluctuations in the speed and direction of the wind.

(28) The term "vertical axis" means a line of reference perpendicular to the plane of the ground.

(29) The term "vertical axis wind turbine" means a SWECS that has an axis of rotation of its rotor perpendicular to the plane of the ground.

(30) The term "wind tunnel test" means the conduct of a SWECS test in artificial wind when the SWECS is mounted in a structure designed to control the wind characteristics during the conduct of the test.

(31) The term "yaw" means the rotation of a horizontal axis wind turbine about its yaw axis.

(32) The term "yaw axis" is the vertical axis about which the directional orientation of a horizontal axis wind turbine is changed.

(c) *Incorporation by reference.* The following documents are incorporated as a part of this standard by reference:

(1) National Electrical Code, 1978 edition, by the National Fire Protection Association

Articles

230 (Services)
250 (Grounding)
280 (Lightning Arresters)
300 (Wiring Methods)
310 (Conductors for General Wiring)
445 (Generators)

(2) Sandia Laboratories Report SAND 77-1375, "Performance Evaluation of Wind Energy Conversion Systems Using the Method of Bins," by Akins, R. E.

(d) *Conflicts of Laws.* Local statutes, regulations, and ordinances that conflict with the requirements of this standard shall take precedence over the requirements of this standard.

(e) *Performance.* The following SWECS performance characteristics shall be determined through testing by the manufacturer or a separate testing organization designated by the SWECS manufacturer. If the manufacturer modifies the SWECS model design which impacts on performance or safety, the new model shall be retested appropriately.

(1) *Net power output.* The SWECS net power output shall be defined as a function of wind speed at the center of the SWECS rotor for wind speeds between 4 and 12 meters per second.

The SWECS net power output curve shall be derived from discrete wind speed and simultaneous power output data using the method of bins. A bin width not greater than 1 meter per second shall be used.

(2) *Annual energy production.* Using the SWECS net power curve for paragraph (e)(1) above, the SWECS annual energy production in kilowatt-hours per year shall be computed for annual average wind speeds of 4.5, 5.4, 6.3, 7.1, and 8.0 meters per second (10, 12, 14, 16, and 18 miles per hour). Calculations shall be made using the following requirements:

(i)The Rayleigh distribution shall describe the wind speed duration curve.

(ii) All reported test data involving power output shall be corrected to a standard air density of 1.2 kilograms per cubic meter, using the following equation:

$$P_S = \frac{D_m}{1.2} \times P_m$$

Where:

P_s = power output (kilowatts) corrected to a standard air density of 1.2 kilograms per cubic meter

P_m = measured power output (kilowatts)

D_m = measured air density (kilograms per cubic meter)

(iii) Reference wind data shall be corrected to the center of the SWECS rotor height using the following equation:

$$V_h = V_m \left(\frac{Z_h}{Z_m}\right)^{1/7}$$

Where:

V_h = corrected wind speed (meters per second) at the center of the SWECS rotor

V_m = measured wind speed (meters per second) at a reference height

Z_m = (meters).

Z_h = height (meters) above ground level to the center of the SWECS rotor.

Z_m = Height (meters) above ground level where the reference wind speed V_m (meters per second) was measured.

(f) *Safety.* The following SWECS safety characteristics shall be determined through testing by the SWECS manufacturer or a separate testing organization designated by the SWECS manufacturer. The SWECS shall be demonstrated to operate safely, without loss of structural integrity under the following conditions:

(1) *Loss of electrical load.* Loss of user electrical load and/or utility electrical system when the SWECS is producing at least 50 percent of rated power.

(2) *Blade imbalance.* Blade imbalance equivalent to an added weight equal to 10 percent of the blade weight, either placed at the center of gravity of the blades or uniformly distributed along the blade. The SWECS shall be capable of safe operation in winds between 4 and 12 meters per second for at least five minutes or until automatic controls stop the machine.

(3) *SWECS de-energization.* It shall be demonstrated that the SWECS connected to a utility electrical system will safely de-energize when the utility electrical circuit to the SWECS is de-energized.

(4) *Manual shutdown.* Safe operation of the manual shutdown subsystem shall be demonstrated if such a subsystem is incorporated in the SWECS.

(5) *Survival wind speed.* The maximum wind speed (meters per second) the SWECS has survived without loss of structural integrity under controlled test conditions shall be provided by the SWECS manufacturer. This data shall be corrected to standard air conditions in accordance with the following equation:

$$V_s = \left(\frac{D_m}{1.2}\right)^{1/2} V_m$$

Where V_s = wind speed (meters per second) corrected to a standard air density of 1.2 kilograms per cubic meter

V_m = measured wind speed (meters per second)

D_m = measured air density (kilograms per cubic meter).

(g) *Installation.* (1) *Manufacturer's instructions.* The manufacturer shall provide detailed installation instruction to the installer of the SWECS which shall meet the following requirements.

(i) The site area and setback limitation shall be the length of one tower height plus one rotor radii from a property line or a right-of-way for electrical transmission or distribution lines.

(ii) As a minimum, the SWECS manufacturer shall provide to the SWECS installer a standard foundation and anchor design (or specification); a detailed parts list; and clearly written detailed instructions for the assembly, installation, and checkout of the SWECS at a typical site.

(iii) As a minimum, the SWECS manufacturer shall provide the installer with the following information and instructions for interconnecting a SWECS to a utilitity company's electrical system:

(A) The installer or his designated representative shall provide information to the local interconnected utility identifying the performance and safety characteristics of the SWECS to be installed, for purposes of evaluating any necessary modification of the local utility's system protection required by the presence of the SWECS in the local utility electrical system.

(B) The local utility shall be responsible for determining that existing as well as new utility-owned protection devices will ensure safe utility operation with the additional generating capability created by the SWECS.

(C) The SWECS to utility electrical interconnection circuit shall incorporate a means to automatically and manually disconnect the SWECS electrically from the utility electrical system in the event of a utility loss of power, an emergency, or servicing of the utility distribution system. The disconnects shall not interfere with reliability of service and the normal operation of circuit breakers, fuses, and other protective devices. The disconnect shall be lockable in the open-circuit position and access to the disconnect shall be available to the utility company at all times.

(D) The SWECS electrical equipment and the method of interconnecting the SWECS to the local utility electrical system and the user electrical load shall conform to the following articles of the National Electric Code (NEC):

NEC Article and Title

230, Services.
300, Wiring Methods.
310, Conductors for General Wiring.
445, Generators.

The local utility company's specification shall apply where the above NEC articles are determined by the local utility to be inadequate or do not address specific hardware and/or power conditioning criteria required by the local utility for interconnecting the SWECS to its electrical system.

(E) The electrical interconnection to the utility electrical/user load shall be electrically located on the user's side of the utility revenue meter and the main distribution panel.

(F) The electrical interconnection shall be made in such a manner as to protect personnel from electrical contact with energized equipment.

(G) Should the local utility require specific interconnect electrical tests to be conducted on the SWECS prior to approval of the interconnection, the test requirements, test methods, instrumentation and calibration requirements, data reduction, data analysis, and reporting shall be specified by the utility and all special tests shall be conducted at a reasonable expense.

(2) *SWECS installation.* The SWECS shall be installed in accordance with the instructions provided by the

manufacturer except that the onsite installation or components used may deviate from the manufacturer's written instructions or the manufacturer's approved components list, if the installer obtains written approval from the manufacturer. In addition, the following requirements shall be met:

(i) Where tower foundation and anchors require modification from the standard design (or specification) provided by the SWECS manufacturer because actual soil condition is not considered normal soil, the installer shall obtain from the SWECS manufacturer, his designated representative, or a registered professional engineer, a foundation/anchor design (or specification) suitable for the characteristics at the site.

(ii) The SWECS shall be grounded and protected against lightning and line transients in accordance with the National Electrical Code Articles 250 (Grounding) and 280 (Lightning Arresters).

(iii) Unauthorized access to the SWECS tower shall be controlled through local ordnances related to attractive nuisance.

(iv) A SWECS shall not be installed in any location where the expected 20-year maximum wind at the proposed site exceeds the design survival wind speed of the SWECS being considered for installation.

(v) Local noise ordinances shall apply, as appropriate, to noise emanating from an installed SWECS.

(vi) Local electromagnetic interferences ordinances shall apply, as appropriate, to any electromagnetic interference resulting from an installed SWECS.

(vii) The installer shall provide the State designated inspection authority (see § 456.313) with a copy of the manufacturer's instructions and a copy of any written approval of deviation from those instructions within 5 days of completing installation.

(h) *Manufacturer reporting requirements—Final test report.* As a minimum, the SWECS manufacturer or his designated testing organization shall document the results of the tests specified in this section in a final test report which meets the following requirements:

(1) *Final test report location.* A copy of the final test report shall be kept on file with the SWECS manufacturer and, if appropriate, his designated testing organization, for a period of 10 years and shall be available for public inspection.

(2) *Type of load.* The type of load (utility grid, battery charging, constant resistance, etc.) size of load (if applicable) and method of load control (if applicable) used in testing shall be stated on the power/wind speed data sheets which shall be documented in the test report.

(3) *Type and location of instrumentation.* The type and location of the instrumentation used for testing shall be specified in the report.

(4) *Calibration of instrumentation.* The method of calibration used, the calibration time interval, and the traceability of the calibration references to the National Bureau of Standards shall be documented.

(5) *State for towing and wind tunnel tests.* Documents showing test data and/or results developed from towing or wind tunnel tests shall include the following statement:

> The (data) (results) presented were derived from (Towing) (Wind Tunnel) tests and may reflect (higher) (lower) (performance) (safety) information than similar data derived from atmospheric tests due to the absence of significant wind turbulence, gusts, and direction changes.

The inappropriate words provided in the above statement shall be deleted before affixing the above statement to the appropriate document.

(6) *Statement for yaw motion restriction.* In documents showing test data and/or results which were derived from tests where the physical limitation of the towing vehicle made conformance to the SWECS yaw motion test requirement of this section impossible or unsafe, the following statement shall be included:

> The (data) (results) were derived from tests where the yaw motion of the SWECS was restricted to ± (To be specified) degrees, and may reflect (higher) (lower) (performance) (safety) information than similar data derived from tests where full yaw motion was allowed.

The inappropriate words provided in the above statement shall be deleted and the number of degrees of yaw restriction shall be added before affixing the above statement to the appropriate document.

(7) *Net power output and annual energy production results.* Tabulated results of the SWECS net power output and the SWECS annual energy production shall be available to the public from the SWECS manufacturers.

(i) *Utility reporting requirements—Final test report.* (A) As a minimum, the local utility shall document any special interconnection tests it required prior to approving the SWECS interconnection in a final test report.

(B) A copy of the final test report shall be kept on file with the local utility for a period of two years and must be available for public inspection.

(C) The final test report shall include but not be limited to the following:

(*1*) Test requirements;

(*2*) Test methods used;

(*3*) Instrumentation used;

(*4*) Calibration requirements;

(*5*) Data reduction methods used;

(*6*) Data analysis and results; and

(*7*) Recommendations and actions required.

(j) *Labeling requirements.* (1) As a minimum, the following information shall be provided in a label attached to the generator housing or similar accessible location:

(i) System net rated power output (kilowatts), the rated wind speed (meters per second and miles per hour) corrected for standard air density and rotor height;

(ii) Maximum current (amperes), load (ohms), load type (resistive, battery charge, etc.);

(iii) Rotor speed at rated power (revolutions per minute);

(iv) Maximum designed rotor speed (revolutions per minute);

(v) Maximum rotor thrust (newtons and pounds force) (not including wind drag on the tower); and

(vi) System weight (kilograms and pounds) on top of tower.

(2) The following information shall be provided on a label or labels easily read from ground level or located at the SWECS control panel:

(i) Maximum survival wind speed (meters per second and miles per hour) and method of determination (test or analysis); and

(ii) Emergency and manual shutdown procedures if applicable.

(k) *Test Methods.* Allowable test methods for the purpose of obtaining the required information on SWECS performance and safety characteristics are atmospheric, towing, or wind tunnel tests. These test methods shall be subject to the following requirements:

(1) *Atmospheric test.* If an atmospheric test is used, the following requirements shall apply:

(i) For a horizontal axis wind turbine, the SWECS rotor shall be located on a tower or support such that the minimum blade clearance above ground level is 2.5 meters.

(ii) Any obstructions to the flow of air into or from the SWECS rotor which are not an integral part of the SWECS and have a total projected frontal area exceeding 25 percent of the rotor-swept area shall not be permitted within a distance of 5 rotor diameters (of the SWECS being tested) in any direction of the SWECS rotor.

(2) *Towing tests.* If a towing test is used, the following requirement shall apply:

(i) The anemometer location shall be such that the wind speed at the anemometer shall be within ±1 meter per second of the wind speed at the location where the center of the SWECS rotor would be if the SWECS was mounted on the towing vehicle when conducting tests to verify compliance with this requirement.

(ii) Any obstructions to the flow of air into or from the SWECS rotor which are not an integral part of the SWECS and have a total projected frontal area exceeding 25 percent of the rotor-swept area shall not be permitted within the cylinder of projection of the SWECS rotor.

(3) *Wind tunnel tests.* If a wind tunnel test is used, the following requirements shall apply:

(i) The SWECS rotor shall be located at the center of the cross-section area of the wind tunnel test section; and

(ii) The SWECS rotor-swept area shall not exceed 10 percent of the free stream cross-section area of the wind tunnel's test section.

(4) *Yaw motion requirement.* During the conduct of the tests, described in paragraphs (k) (1) through (3) of this section, the SWECS shall be free to operate in its normal configuration in yaw for all yaw motions ±90 degrees from the nominal average wind direction wherever possible. If physical limitations of a towing vehicle make this impossible or unsafe, a physical limitation on the amount of yaw motion is permitted. A disclosure shall be provided with the test results specifying the amount of yaw motion allowed during the test and its effect on the data and results obtained. This requirement does not apply to a vertical axis SWECS.

(5) *Data analysis requirement.* Performance testing shall be conducted over a range of wind speeds including, but not limited to, the interval between 4 meters per second and 12 meters per second. The wind duration at each bin in the interval must satisfy at least one of the following conditions:

(i) The wind speed must be recorded in the given bin for a duration not less than 5 percent of the total test duration;

(ii) The wind speed must be observed in the given bin for at least one minute; or

(iii) The wind speed in the given bin must have been recorded for at least 100 independent observations.

The bin width shall not be greater than 1 meter per second.

(6) *Instrumentation.* The instrumentation used to conduct the tests specified in this section shall meet the following requirements:

(i) The anemometer system used to measure wind speed shall have an accuracy equal to or greater than ±10 percent of reading over the range 4 to 12 meters per second and an anemometer distance constant equal to or less than 10 meters.

(ii) Electrical power output of the system shall be measured or calculated from measured values with an accuracy of ±1 percent of reading.

(iii) All readout or recording devices shall have an accuracy of ±5 percent of reading, a frequency response of at least 0.1 Hertz, and shall be capable of recording or displaying simultaneous wind speed and power output data.

(iv) The anemometer shall be located not less than 1 SWECS rotor diameter and not more than 10 rotor diameters from the center of the SWECS rotor, except that if the anemometer is downwind of the rotor and at a height at or near that of the center of SWECS rotor (±1.5 rotor radii), it shall be not less than 5 rotor diameters nor more than 10 rotor diameters from the location of the SWECS rotor. All wind speed values must be corrected to the height at the center of the SWECS rotor using the locally measured wind shear profile or, if wind shear measurements are not available, the data shall be corrected using the following equation:

$$V_h = V_m \left(\frac{Z_h}{Z_m} \right)^{1/7}$$

Where

V_h = Corrected wind speed (meters per second) at the center of the SWECS rotor Z_h (meters).

V_m = Measured wind speed (meters per second) at a reference height Z_m (meters).

Z_h = Height (meters) above ground level to the center of the SWECS rotor.

Z_m = Height (meters) above ground level where the reference wind speed V_m (meters per second) was measured.

(v) The electrical power instrumentation shall measure the power delivered from the SWECS generator, minus any power used to control the SWECS.

(vi) The calibration of the instrumentation used in the tests specified in this standard shall be traceable to the National Bureau of Standards. The calibration shall be current within the time interval specified by the testing organization.

(7) *Testing organization certification.* The organization conducting any test outlined in this standard shall self-certify that it has met all the testing requirements stated in this standard. A signed statement of compliance with this standard shall be kept on file with the SWECS manufacturer and the organization that conducted the test for a period of 10 years.

§ 456.810 Standard for urea-formaldehyde foamed-in-place insulation.

(a) *Scope.* This section applies to urea-formaldehyde foamed-in-place insulation of existing residential buildings. This material is approved for exterior sidewall application only, and is not approved for use in attics, above ceilings, or under floors.

(b) *Definitions.* (1) "Urea-formaldehyde foam, insulation" (U-F foam) is a cellular plastic material generated in a continuous stream by mixing the components which are an urea-formaldehyde resin, air, and a foaming agent.

(2) "Foamed-in-place" means sprayed or pumped in place to form rigid or semi-rigid insulation in its permanent location.

(3) "Insulation manufacturer" (manufacturer) means the installer who combines these component materials and foams the insulation in place.

(4) "Component-material supplier" (supplier) means the supplier of the resin, foaming agent, and other ingredients to the foam insulation manufacturer.

(5) "ANSI/ASTM B 152–79" means ANSI/ASTM Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar.

(6) "ANSI/ASTM B 446–75" means ANSI/ASTM Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloy Rod and Bar.

(7) "ASTM C 177" means ASTM Standard Test Method for Steady State Thermal Transmission Properties by Means of the Guarded Hot Plate.

(8) "ASTM C 236–66" means ASTM Standard Test Method for Thermal Conductance and Transmittance of Built-Up Sections by Means of the Guarded Hot Box.

(9) "ASTM C 518–76" means ASTM Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter.

(10) "ASTM D 257" means ASTM Standard Test for D-C Resistance or Conductance of Insulating Materials.

(11) "ASTM D 1622" means ASTM Standard Method of Test for Apparent Density of Rigid Cellular Plastics.

(12) "ASTM E 84" means ASTM Standard Test Method for Surface Burning Characteristics of Building Materials.

(c) *Coverage.* The component material supplier is responsible for ensuring that the requirements contained in this section have been met in all operations

through and including time of delivery to the insulation manufacturer.

(d) *Material requirements.* (1) *Thermal resistivity.* Thermal resistivity shall be tested in accordance with the test method described in paragraph (e)(2) of this section. Thermal resistivity for any given specimen of U-F foam insulation shall not be more than 5 percent below the arithmetic average of the resistivities of the foam specimens tested. Effective thermal resistivity of U-F foam shall be computed as 60 percent of the laboratory thermal resistivity value.

(2) *Fire safety.* The flame spread classification of U–F foam insulation shall not exceed 75, when tested in accordance with ASTM E 84.

(3) *Corrosiveness.* When tested as specified in paragraph (e)(3), the corrosion rates shall not exceed the values specified in Table XIII below.

Table XIII

Metal	Corrosion rate
Carbon Steel	0.15 mm/yr (0.006 in./yr)
Copper	0.025 mm/yr (0.001 in./yr)
Galvanized Steel	0.09 mm/yr (0.0035 in./yr)
Aluminum	0.025 mm/yr (0.001 in./yr)

(4) *Density.* (i) The dry density of U–F foam insulation shall be no less than 10.4 kg/m ^{3} (0.65 lb/ft ^{3}) when tested in accordance with ASTM D 1622.

(ii) The wet density of U–F foam insulation five minutes after foaming shall be between 40 kg/m ^{3} and 88 kg/m ^{3} (2.5 lb/ft ^{3} and 5.5 lb/ft ^{3}) when tested as specified in paragraph (e)(4).

(5) *Water absorption.* Under conditions specified in paragraph (e)(5)(i) of this section, the water absorption of U–F foam insulation shall not exceed 15 percent by volume. When tested in accordance with paragraph (e)(5)(ii) of this section, U–F foam shall not absorb the droplets of methyl violet solution in less than one hour.

(6) *Free formaldehyde content.* (i) The free formaldehyde content of the resin used in U–F foam insulation shall not exceed 0.5 percent by weight when tested as specified in paragraph (e)(6).

(ii) The free formaldehyde content of fresh U–F foam shall not exceed 0.3 percent by weight when tested as specified in paragraph (e)(7).

(7) *Setting time.* U–F foam insulation shall set in not less than 20 seconds and not more than 60 seconds when tested in accordance with paragraph (e)(8).

(8) *Volume resistivity.* The volume resistivity of fresh U–F foam shall be not less than 5 k Ω-cm when tested as specified in paragraph (e)(9).

(9) *Water drainage.* U–F foam insulation shall manifest no water leakage from a plywood cavity when tested in accordance with paragraph (e)(10) of this section.

(10) *Shrinkage.* U–F foam insulation shall not shrink more than 4.0 percent in any direction when subjected to the conditions specified in paragraph (e)(11) of this section.

(11) *Labeling.* (i) Containers of urea-formaldehyde resin and foaming agents shall have labels showing storage temperatures and dates (shelf-life) after which resin and foaming agent are not usable.

(ii) The following warning shall be printed on U–F resin containers and shall be printed for manufacturers to present to residents prior to the installation of U–F foam insulation:

Caution: Under some conditions Urea Formaldehyde insulation may cause the release of formaldehyde gas into living areas, and the development of adverse health effects. Continued exposure to formaldehyde can cause nausea and vomiting, respiratory difficulties, headaches, eye irritation, and allergic reactions. Such symptoms may develop anywhere from a few days to more than six months after the gas is released.

(12) *Additional requirements.* (i) The supplier of the U–F foam components shall train and certify the manufacturers of U–F foamed-in-place thermal insulation. An approved training course and certification requirement shall require proficiency in the following:

(A) Principles of heat transfer and thermal insulations

(*1*) Condensation control/vapor barriers

(*2*) Effects of moisture on thermal insulations

(*3*) Air infiltration

(B) Overview of U–F foam insulation

(*1*) Physical properties

(*2*) Mechanical properties

(*3*) Thermal properties

(*4*) Chemical properties

(C) U-F Foam technology

(*1*) Manufacture and composition of U-F foam components, i.e., resin and catalyst solutions

(*2*) Chemical reactions during production of U-F Foam and of final foamed product

(*3*) Field manufacture of U-F foam *in situ*

(D) Post-installation curing of U-F foam

(*1*) Shrinkage

(*i*) Normal

(*ii*) Excessive

(*2*) Formaldehyde release

(*i*) Inherent post-installation release

(*ii*) Solids content of components and foam

(*iii*) Factors affecting rate of drying

(E) Installation procedures

(*1*) General guidelines

(*i*) Vapor barriers

(*ii*) Wall venting

(*iii*) Drilling and plugging requirements

(*iv*) Problem installations

(*2*) Specific guidelines (covers opening and closing techniques and equipment and tools to use)

(*i*) Brick-on-brick

(*ii*) Concrete block

(*iii*) Brick veneer

(*iv*) Drill and plug

(*v*) Wood shingle and wood shake siding

(*vi*) Slate shingles

(*vii*) Aluminum, vinyl, and steel siding

(*viii*) Clapboard wood siding

(*ix*) Stucco and pebbledash

(*x*) Imitation brick asphalt roll or sheet

(*xi*) Balloon construction

(*xii*) Mobile homes

(*xiii*) Pipe chases

(*xiv*) Knee wall areas

(*xv*) Windows and door frames

(*xvi*) Below grade

(*xvii*) Other applications

(*xviii*) Restricted applications

(F) Proper cavity fill techniques

(*1*) Stud cavity

(*x*) Check for obstructions

(*ii*) How to determine number of holes per cavity necessary for complete fill

(*iii*) Methods of preventing overpressurized or ruptured walls

(*iv*) Demonstration of proper fill technique

(*2*) Continuous cavity, i.e., brick-on-brick

(*i*) Methods of preventing overpressurized or ruptured walls

(*ii*) Demonstration of proper fill technique

(*3*) Other cavities

(*i*) Methods of preventing overpressurized or ruptured walls

(*ii*) Demonstration of proper fill technique

(G) Resin and foaming agent/catalyst handling

(*1*) Storage conditions

(*2*) Solution temperatures during application

(*3*) Shelf life

(*4*) Safety precautions

(*5*) Shipping requirements

(H) Practical demonstration

(*1*) Proper foaming technique

(*i*) Pre-foaming quality control checks

(*ii*) Pre-installation quality control checks

(*iii*) Quality control checks during installation

(*2*) Trouble shooting off-specification foam

(*i*) Off-ratio foam

(*ii*) Incorrect density foam

(*iii*) Over aged resin

(*iv*) Incorrect solution temperatures

(*v*) Faulty, malfunctioning or inadequate equipment

(*vi*) Overacidified or underacidified foaming agent

(*vii*) Effects of using equipment not properly maintained

(I) Equipment

(*1*) Supplier's recommended equipment

(*2*) Proper care and maintenance

(*3*) Troubleshooting

(J) Recordkeeping

(*1*) Required disclosures to consumer

(*2*) Manufacturer's required recordkeeping

(ii) Following the supplier's training programs, and successful completion of a comprehensive examination, manufacturers will then be certified to apply U–F foam insulation.

(A) The supplier shall issue application licenses to the cerrtified dealers and maintain a current roster of its licensed manufacturers.

(B) Annual or semi-annual refresher courses and recertification examination shall be required for each manufacturer to maintain his certification.

(C) Manufacturers trained by a supplier other than their current supplier must use equipment that complies with the current supplier's specifications and must successfully complete that supplier's cerification requirements. Complete re-training is not necessary but is at the current supplier's discretion.

(D) On-site spot checks of installations shall be conducted by the supplier.

(iii) The supplier of the U–F foam components shall provide materials control and installation instructions.

(iv) The supplier of the U–F foam components shall recommend the equipment to be used to manufacture the U–F foamed-in-place thermal insulation. The equipment shall at a minimum meet the following criteria:

(A) The pumping-delivery equipment shall deliver air, dilute resin and dilute foaming agent to the mixing device in the proper flow and volume ratio prescribed by the manufacturer of the materials.

(B) A device shall be included to alert the operator or automatically shut down the system should performance specifications go out of tolerance. Wet density shall be manually adjusted and will not be subject to the alarm or shutdown requirements.

(C) The system shall have provisions to prevent or control oil contamination and/or water condensation in the air supply.

(e) *Test methods.* (1) *Preparation of specimens.* Neither the specimen composition nor foaming conditions shall be altered to produce qualifying samples for the tests required in this section. All tests described in this section shall be conducted on the same batch of U–F foam insulation (made from the same resin, foaming agent, and additives) and under the same conditions. Unless otherwise specified in the following test procedures, the foam shall be prepared and applied in accordance with the supplier's instructions and specified equipment. The temperature of the unreacted materials prior to foaming shall be between 15° and 32° C (59° and 90° F). Unless otherwise specified, specimens shall be foamed at ambient conditions of 23±2° C (73±4° F) and 50±5 percent relative humidity into closed cavities constructed of (nominal) 2 x 4 inch studs (51 x 102 mm) and ½ inch (13 mm) thick exterior grade plywood. Maintain test specimens in the closed cavities in vertical positions at 23±2° C and 50±5 percent relative humidity for 28 days prior to testing. Then remove specimens from cavities and condition at 23±2° C (73±4° F) and 50±5 percent relative humidity until a constant weight (±1.0 percent) is maintained over a three day period.

(2) *Test method for thermal resistivity.* (i) The laboratory value of thermal resistance shall be determined as specified in ASTM C 177, ASTM C 518–76 or ASTM C 236–66, using specimens 75+0, −1 mm (3 in, +0, −.04 in.) thick, a mean temperature of 24° C (75° F) and a mean temperature differential across the specimen of 22±3° C (72±5° F). In cases of a question, ASTM C 177 shall be used. Specimen surfaces shall be either those obtained during foaming or those obtained by slicing the material to remove not more than 5 mm from each side.

(ii) The effective thermal resistance shall be computed as 60 percent of the laboratory thermal resistance value determined by the preceding paragraph.

(3) *Test method for corrosiveness.* (i) The following apparatus and materials shall be used to test for corrosiveness:

(A) Oven capable of maintaining 40±2° C (104±4° F).

(B) Small container, approximately 90 x 50 mm (3.6 x 2 in.) made of inert material such as polypropylene and equipped with a lid so designed that water condensing on it will not drip but will run to the walls of the container. The container shall be designed such that it is not potentially hazardous after it has been sealed at room temperature and heated to 40° C (104° F).

(C) Large container, capable of housing the small container, but which will fit inside the oven.

(D) Test coupons, approximately 50 x 50 mm x 0.0762 mm (2 x 2 x .003 in) thick metal, free of tears, punctures or crimps as follows: 3003 Bare Aluminum, soft temper; ANSI/ASTM B 152–79 type ETP, Cabra No. 110, soft copper; and low carbon, commercial quality, cold rolled shim steel.

(E) Test coupons, approximately 50 x 50 x 1.0 mm (2 x 2 x .004 in) made from hot dipped galvanized sheet steel conforming to Grade A or B, ANSI/ASTM B 446–75 with a total zinc coating of 275–0, +31 g/m². At least 40 percent of the zinc shall be on any one side of the test coupons. (Metal of this quality is used in the manufacturer of truss plates).

(F) 1,1,1-trichloroethane analytical reagent grade. (It has been established that exposure to trichloroethane may present a health hazard and precautions should be taken.)

(G) Balance, capable of determining the mass of the galvanized specimen to an accuracy of 1 mg.

(H) 40 Watt appliance light bulb.

(I) Distilled water, nitric acid 1.002 kg/L, ammonium hydroxide (relative density 0.90), chromium trioxide, silver nitrate, hydriodic acid, reagent grade chemicals.

(J) Several noncorrosive plastic supports and a 150 g mass.

(ii) Prepare foam specimens from blocks. Cut a specimen 60 x 60 mm (2.4 x 2.4 in) square and 15 mm (0.6 in) thick from blocks such that the 60 x 60 mm (2.4 x 2.4 in) surface is that obtained from foaming and not slicing the foam. All other surfaces of the specimen shall be obtained by slicing the foam. Surfaces obtained from foaming shall be placed adjacent to the metal specimens in the test.

(iii) Make duplicate tests for each determination. Wash the metal coupons with 1, 1, 1-trichloroethane to remove any oil or grease. Wash the cleaned specimens under water and ensure they are completely wetted by the water and contain a water-streak free surface. At no time shall the metal coupons be touched with ungloved hands. Handle the cleaned metal specimens with clean forceps. Dry the metal coupons at room temperature. Weigh the coupons and record their masses. Place a noncorrosive plastic screen support in the small container and add 20 mL (deionized) water. Place a foam block on the support at least 5 mm (0.2 in) above the surface of the water. Place the metal coupon on the foam block, put another foam block on the metal coupon and then place on top of the sandwich a non-corrosive plastic screen and a 150 g mass which shall not block air flow to the top foam block. Seal the small container with a lid. Place the small container in the large container, add

sufficient distilled water to the large container and seal it. Place the assembly in an oven at 40 ± 2°C (104 ± 4°F) for 28 days. Upon completion of the test remove the assembly from the oven and dismantle. The large container should still have some water in it. If there is no water present at the end of the test, then results for those materials passing the test are suspect and the test should be repeated. Remove the corrosion products from the metal coupons by the procedures recomended in ASTM Gl. Rinse all metal coupons in distilled water and dry. Examine the specimen and control coupons. The controls shall be metal coupons not exposed in the oven but which are cleaned identically to the specimens. Subtract the loss in mass of the controls from the loss in mass of the specimen coupons. For each set of duplicate specimens to meet the requirements of paragraph (d)(3), the spread between results shall not exceed an absolute value equal to 15 percent of the maximum permissible corrosion rate specified for that material and the average of both results shall be below that maximum limit set for that material.

(iv) Calculations. Corrosion rates shall be calculated by the following equation:

$$\text{Corrosion Rate (mm/yr)} = \frac{87.6 \times W}{A \times T \times D}$$

Where:

W = weight loss in mg to the nearest 0.2 mg
A = total surface area in cm^2 to the nearest 0.01 cm^2
T = time of exposure in hours to the nearest 0.01 hr
D = density in g/cm^3

(4) *Test method for wet density.* Weigh to the nearest gram a measured quantity of freshly foamed material in a tared container within five minutes after formation. Calculate wet density using the formula:

$$\text{Density (kg/m}^3\text{)} = 1{,}000 \times \frac{\text{Weight (g)} - \text{Tare Weight of Container (g)}}{\text{Volume (cm}^3\text{)}}$$

(5) *Test methods for water absorption.* (i) Floating test. Cut three cubes, each 180 × 180 × 90 mm (7.1 × 7.1 × 3.5 in) from a block of foam. Accurately weigh each cube and place them singly on a distilled water surface. The surface in contact with the water shall be that obtained from foaming. After seven days at 23 ± 2°C (73± 4°F) and 50 ± 5 percent R.H., remove the cubes and accurately weigh them. Calculate the percentage of water absorption on a volume basis.

(ii) Droplet test. Prepare a 0.3 percent solution of methyl violet in distilled water. Apply five drops each 0.03 mL, of the solution by means of a syringe to a freshly cut horizontal surface of the foam and to a surface obtained from foaming. Measure the time required by the drops to be completely absorbed through the surface of the foam. This point in time shall be ascertained under direct lighting at the moment when the area to which the drop has been applied become dull. Perform the test at 23 ± 2°C (73 ± 4°F) and 50 percent R.H.

(6) *Test method for free formaldehyde content of resin.* Prepare a standard sulfite solution as follows: Dissolve, without heating, approximately 250 g $Na_2SO_3 7H_2O$ in about 200 mL distilled water. Dilute to one litre. Adjust the pH of the sulfite solution to 8.9 with H_2SO_4, and NaOH solutions. The solution is stable only for a short period of time and it must be used immediately after adjustment of the pH. Place 20 mL distilled water in an Erlenmeyer flask. Accurately weigh approximately 2 g resin solution (ready for foaming) and add it to the flask. Stir the mixture well, add approximately 10 g crushed ice and mix thoroughly. Add 50.0 mL of the standard sulfite solution and titrate immediately with 0.49 g/L H_2SO_4 to pH 8.9. Perform the procedure in duplicate and run a blank. Calculate the percentage formaldehyde content of the resin as follows:

Percent formaldehyde = 3(A–B)D/C

Where:

A = mL of 0.49 g/L H_2SO_4 for the specimen
B = mL of 0.49 g/L H_2SO_4 for the blank
C = mass of resin solution, g
D = normality of the H_2SO_4 solution.

(7) *Test method for free formaldehyde content of fresh U–F foam.* This test shall be conducted on three foam specimens taken from the same slab of foam and one blank. These specimens shall be taken 60 minutes after foaming.

(i) The following apparatus is required:

(A) Four 1000 mL breakers
(B) Mechanical stirrer
(C) 50 mL graduate cylinder
(D) One 100 mL graduate cylinder
(E) Top-loading automatic balance, sensitivity 0.01 g
(F) Two titration burettes, 50 mL capacity,

(ii) Prepare a sulphite solution (1 molar) by dissolving, without heating 252 g $Na_2SO_3 7H_2O$, or 126 g of Na_2SO_3, in about 400 mL of formaldehyde-free distilled water. Dilute to 1000 mL in a volumetric flask. Adjust the pH of the sulphite solution to 8.9 with 0.1 N H_2SO_4, or 0.1 N NaOH solution. The solution is stable only for a short period of time and must be used immediately after adjustment of the pH. To increase its stability, store in a dard cool place.

(iii) Weigh the 1000 mL beakers.

(iv) Cut three foam samples, approximately 50 × 50 × 75 mm (2 × 2 × 3 in) each, and place each in a separate 1000 mL beaker. Re-weigh the beakers and determine the weights of the foam samples.

(v) Compress foam sample to the bottom of the beaker and add 400 mL of a water/methanol mixture (50/50 by volume), previously cooled to 0°C. Mix well, adjust to pH 8.9 with 0.1 N NaOH, and allow to stand for two (2) hours in an ice bath maintaining 0°C.

(vi) For blank, add 200 mL of formaldehyde-free distilled water and 200 mL methanol to 1000 mL beaker and cool at 0°C.

(vii) Add 0.1 N sodium hydroxide (NaOH) solution, dropwise, to pH 9.0 or back titrate with 0.1 N sulphuric acid (H_2SO_4) to a pH of 9.0.

(viii) Quickly add 10 g of cracked ice (2 tablespoons) to one of the beakers only and stir or mix thoroughly. To this beaker, immediately add 50 mL of standard 1 molar sodium sulphite solution from a graduate cylinder and titrate at once with 0.1 N sulphuric acid to a pH of 9.0. Record the number of mL of 0.1 N sulphuric acid in this titration.

(ix) Repeat procedure in Step 6 for the second and third foam sample beakers.

(x) Run the blank by adding 10 g (2 tablespoons) of cracked ice and then quickly adding 50 mL of standard 1 molar sodium sulphite solution from a graduated cylinder, and titrate again with 0.1 N sulphuric acid to a colorless end-point (pH 9.0). Record the number of mL of 0.1 N sulphuric acid added to the blank solution.

(xi) The percentage of free formaldehyde contained in the foam shall be determined by the following equation

$$\text{Percentage Formaldehyde} = \frac{3.003\ (A-B)D}{C}$$

A = mL of 0.1 N H_2SO_4 titrant added to the blank sample
B = mL of 0.1 N H_2SO_4 added to the sample
C = weight of foam in g
D = normality of the H_2SO_4 solution

(8) *Test method for setting time.* A conical specimen with a bottom diameter of approximately 30 cm (12 in) and a height of approximately 30 cm (12 in) shall be made by foaming from a hose. Start a stopwatch immediately after the cone has been formed and immediately commence slicing the cone with a spatula. Record the time when

the foam no longer slices as if it were whipped cream but shears off leaving a smooth surface. This time is the setting time.

(9) *Test Method for Volume Resistivity of Fresh Foam.* Foam the specimen in a plastic box which is made of non-conductive plastic and so designed that it may be opened for easy cleaning. Provide slits in the box to accomodate the brass electrodes forming a 90 mm (3.5 in) cube of foam when they are inserted into the box. The box shall be equipped with grooves, about 2 mm (0.08 in) in depth on the interior between the slits, to act as guides for the electrodes. Insert the electrodes into the slits, through the foam and through the other slits. The bevelled edge of the electrodes shall face outwards during insertion so that the foam specimen is not compressed. Then determine the volume resistivity of the foam in accordance with ASTM D 257 using a potential difference of 110V. the time between foaming the specimen and taking the instrument reading shall not exceed 30 seconds.

(10) *Test method for water drainage.* Prepare a cavity approximately 2440 mm high, 400 mm wide and 90 mm deep (97.6 × 16 × 3.5 in) from wood studs and plywood. Fill the cavity by foaming in place or trowelling. Leave the cavity in a vertical position for 24 hours, during which time the bottom and underside of the structure shall be examined for water. The cavity shall be built so that any free water from the foam can run out easily at the bottom. Caulks, sealants, and adhesives are not to be used in the construction of the cavity.

(11) *Test method for shrinkage.* Construct three boxes, approximately 480 × 480 × 90 mm (19 × 19 × 3.5 in) from nominal 2 × 4 in wood studs and exterior grade plywood. Fill these three boxes with U–F foam, cover them, and maintain for 28 days at 23± 2°C (73 ± 4°F) and 50 ± 5 percent R.H. Then open the boxes and measure the linear shrinkage of the U–F foam in the two principal directions. Report the average of all six determinations as linear shrinkage. If fractures in the specimens occur, the data shall be discounted, and the test repeated.

§ 456.812 Standards for caulks and sealants, water heater insulation, heating/air conditioning duct insulation and pipe insulation.

* * * * *

(e) *Material standard for pipe insulation.* Pipe insulation shall conform to:

(1) Federal Speicification HH–I–558B, Federal Specification for Mineral Fiber Batts and Blankets—Industrial Type, or

(2) Federal Specification HH–I–573B, Organic Cellular Flexible Unicellular pipe covering.

In addition, the exterior facing shall have a flame spread, when tested in accordance with ASTM E–84, of no more than 25.

456.814 Standards for furnace efficiency modifications.

* * * * *

(f) *Material standard for automatic intermittent pilot ignition systems (IID's) for gas-fired heating systems. (1) All IID's shall conform to ANSI Z21.20–1975, entitled "American National Standard for Automatic Gas Ignition Systems and Components."*

(2) All IID's shall contain a label stating: "This device should be installed only by approved contractor."

(3) Manufacturers of IID's shall provide to all persons approved for installing the device specific wiring diagrams for all situations in which the IID may be installed.

(g) *Material standard for vent dampers for gas-fired systems.*

* * * * *

(3) *Wiring diagrams and Instructions.* In addition to meeting the above requirements, manufacturers shall provide all persons approved for installing the device with:

(i) Specific wiring diagrams, which show how to connect electrical vent dampers and thermal vent dampers with electrical connections to those appliances with which the vent damper is compatible.

(ii) Specific interconnection diagrams between the motive force and control circuits of those appliances with which a mechanical vent damper is compatible.

(iii) Instructions for installing an additional automatic gas valve when installing thermal vent dampers.

(iv) A verification-of-installation card to be returned to the manufacturer by the installer. The following information shall be requested on the card:

(A) Name of Installer.

(B) Name of Installer's Company.

(C) Name and Address of Purchaser.

(D) Model and Type of Device Installed.

(E) Date of Installation.

§ 456.905 Standard practice for the installation of loose-fill thermal insulation.

* * * * *

(d) *Installation Procedures.* (1) *General* * * *

(ii) Structural damage can be caused by excessive pressures during the installation or can result form installing insulation in constructions too weak to support the imposed load. Install insulation only so as not to cause any of the following conditions:

(A) Separation of finish materials from joists or studs.

(B) Cracking of materials or opening of joints between boards.

(C) Defection of more than 1/200 of the joist or stud spacing.

Note 5.—The following table, which is based on tests and other data submitted by gypsum board manufacturers, may be used to determine whether a gypsum board surface is likely to exceed the maximum allowable deflection specified above. Actual deflection or other failure in service depends on various factors such as:

- Whether the gypsum board is installed with its long side parallel or at right angles to the joists.
- Relative humidity.
- Temperature conditions.

Table 1.—*Maximum Suggested Loads*

(1) Gypsum board ceiling thickness	(2) Frame spacing	(3) Suggested load [1]
½ in.	24 in o.c.	1.3 psf.
½ in.	16 in o.c.	2.2 psf
⅝ in.	24 in o.c.	2.2 psf.

[1] Includes the weight of both the new and any existing insulation.

§ 456.909 Standard practice for the installation of urea-formaldehyde foamed-in-place insulation.

(a) *Scope.* (1) This practice covers the installation of Urea Formaldehyde foam insulation (U-F foam) in exterior wall cavities of existing residential buildings.

(2) This practice covers the installation process from pre-installation procedures through post-installation procedures. It does not cover the manufacturing of the material components, but it does cover the process of combining components to form foam and it also covers field quality control checks.

(3) This practice provides minimum requirements that will help to insure the installation of insulation in a safe and effective manner. It must be noted that actual conditions in existing buildings vary greatly and in some cases substantial additional care and precaution may have to be taken to assure effective and safe installation.

(4) This practice covers aspects of installation relating to the safety of persons and property, effectiveness, and durability of insulation in service, and prevention of related structural damage to the residence.

(b) *Definitions.* The definitions in § 456.810(b) apply to this section.

(c) *Significance.* (1) This practice recognizes that effectiveness, durability,

prevention of related structural damage, and safety of insulation depends not only on the quality of the insulation materials, but also on their proper and workmanlike installation.

(2) Improper installation of U-F foam may reduce its thermal effectiveness, cause damage to the structure, and cause unsafe conditions.

Note.—Specific hazards that can result from improper installation include:

a. Deterioration or failure of electrical wiring components and heat buildup caused by overfused electrical circuits or by exposed metal wire conductors, when wiring is encapsulated in thermal insulation;

b. U-F foam insulation may release formaldehyde vapor. This occurrence may present a health hazard to the building's occupants.

c. Deterioration of wood structures, paint failures, and corrosion of metal fasteners and electrical components caused by prolonged moisture accumulation within building components.

d. Foam penetration into electric services, cracks, gaps (moldings), heating ducts and passages, interior partition walls and floors not meant to be insulated, recessed electrical or storage components, etc.

e. Buckling, breaking, and cracking of interior or exterior surfaces due to over pressurization or defective construction workmanship or materials, sometimes not related to the insulation.

f. Rendering window mechanisms inoperative or partially operative (blockage of weights by foam, etc.)

(d) *Safety Precautions.* (1) Wear safety equipment to protect hands and eyes against acid contained in the chemicals.

(2) Avoid contact between the uncombined chemical components of U-F foam and building materials to prevent staining or corrosion.

(3) Follow label instructions regarding hazards related to the materials.

(4) Observe all safety rules provided by the installation equipment manufacturer. Properly set relief valves on pressurized liquid and air vessels and exercise proper use of electrical power tools.

(5) Keep all persons not involved in the installation a safe distance from work areas and installation equipment.

(6) Maintain proper ventilation on the job to prevent excessive exposure to formaldehyde gas.

(7) Follow the supplier's instructions for storage of U-F foam components and follow proper methods of disposal of old or unusable resin and foaming agent solutions.

(8) Turn off all power to circuits located within the wall cavities being insulated.

(e) *Installer requirements.* (1) The installation of U–F foam may only be performed by insulation manufacturers trained and certified by the material components supplier.

(2) Persons installing U–F foam must have a working knowledge of the applicable codes and regulations, tools, equipment, and methods necessary for the installation of thermal insulation materials. These persons are also required to have an understanding of the fundamentals of residential construction that affect the installation of insulation.

(f) *Equipment.* (1) Use only equipment which has been recommended by the supplier for use with the supplier's product and has within a period of less than six (6) months prior to the current installation successfully passed the testing requirements of paragraph (f)(4) of this section using the procedures described in paragraph (f)(5).

(2) Ensure that hose lengths conform to the insulation supplier's requirements.

(3) Check the equipment for proper functioning and cleanliness before starting a job. Clean and maintain the equipment according to the equipment manufacturer's instructions but at a minimum, at the following intervals:

(i) Before installing each new batch of U–F foam.

(ii) After every down time of at least 15 minutes.

(iii) At the conclusion of the installation process.

(4) *Equipment testing requirements.* (i) The volume flows shall be consistent from the beginning to the end of continuous foaming operations of a quantity of 20 ± 5 gallons of both resin and foaming agent to within a tolerance of ± 5 percent of the standard set out in paragraph (f)(5)(i) of this section.

(ii) The ratio of flow between the liquid ingredients shall be consistent from beginning to end of continuous foaming of a quantity of 20 ± 5 gallons of both liquid ingredients to within a tolerance of ± 5 percent from manufacturer's prescribed ratio between the liquids when tested in accordance with the test method specified in paragraph (f)(5)(i).

Example. Assuming 20 gallons of foaming agent used and 20.5 gallons of dilute resin, the ratios would be 1 to 1.025 foaming agent to dilute resin, which is an acceptable ratio for a product required to maintain a 1 to 1 ratio.

(iii) The wet density of the U–F foam shall be consistent from beginning to end of continuous foaming of a quantity of 20 ± 5 gallons of both liquid ingredients to within a tolerance of ± 5 percent of the supplier's test procedure. A minimum of three density tests must be taken over the 20 ± 5 gallons pumped of both liquids (shortly after start, middle, and just before the end).

(iv) Alarm shut-down mechanisms shall be tested per paragraph (f)(5)(iii). Equipment that fails the flow ratio per paragraph (f)(5)(i) but does not activate the alarm or shutdown mechanism, constitutes noncompliance to this standard. For each test per paragraph (f)(5)(i) that fails, an additional, successful test must be run. A test failure is one that was interrupted because of alarm or shut-down mechanism being activated. Special provision is given for ultra-sensitive equipment per paragraph (f)(5)(iii).

(v) The equipment shall be subject to a cyclic performance test to simulate typical wall filling conditions. Ten on-off cycles (30 ± 5 seconds on and 15 ± 5 seconds off) shall be run without causing out-of-tolerance flow ratios. The wet density of foam on the first cycle shall be within the supplier's specification and when compared with a wet density test after the last cycle, shall be within ± 5 percent of that from cycle one. Cleaning of the exit hose or other components in contact with mixed ingredients is allowed prior to final wet density test. The ratio of flow between the liquid ingredients shall be within a tolerance of ± 5 percent from the supplier's prescribed ratio between liquid when tested in accordance with the paragraph (f)(5)(iii) test method. The provisions of paragraph (f)(4)(iv) shall apply to this cyclic performance.

(5) *Equipment testing procedures.* (i) Measure the volumes of ingredients consumed while making U–F foam to an accuracy of ± 2.0 percent of full scale. A plastic pipe with a sight glass connected in a verticle position can be calibrated to serve as a graduated column. Set up and prime the liquid systems after connecting the graduated column. Make trial U–F foam to achieve the supplier's proper specification. Note the level of both liquid ingredients in the graduated columns prior to measurement during timed trials. On continuous pumping trials, a minimum of four sets of readings must be taken and spaced uniformly over the pumping period. The elapsed time between each reading must be determined to ± 2.0 percent. If the prescribed amounts of liquid are made into U–F foam and no automatic alarm or shut down has occurred, collect the data as described below:

(A) For each time interval, determine the volume pumped and the time; calculate the ratio of foaming agent to resin of each time interval.

(B) Calculate the overall ratio for the total test period.

(C) Calculate the gallons per minute flow rate for each time interval.

(D) Calculate the total volume pumped for foaming agent and resin at the completion of the test. The foam density at the completion of the test shall be determined per the supplier's prescribed method to specification.

(E) Verify that alarm or shut down devices are working properly per paragraph (f)(5)(iii) since they were not activated during the test.

(ii) The cyclic testing shall measure the volumes of ingredients consumed while making U–F foam to an accuracy of ± 2.0 percent of full scale using graduated columns as described in paragraph (f)(5)(i) of this section. Perform the prescribed checks and note the liquid levels. Perform the prescribed cycle of operations per paragraph (f)(4)(v). Measure the total volume of ingredients used and determine the overall ratio.

(iii) Testing of the alarm or shut down device shall be carried out by another trial per paragraph (i) above, but a progressive restriction of flow of one ingredient shall be induced on the system. This can be done on many systems by crimping a supply hose leading to the mixing device to diminish flow. If the alarm or shut down device fails to activate within five (5) minutes, the system does not comply to this standard. If the system has both alarm and shut down capabilities, the activation of either shall be sufficient for the system to meet this standard. Systems which maintain ratio but give false alarms shall not be rejected, but they will be so classified.

(g) *Foam Generation and Field Quality Control Checks.* (1) Follow the supplier's instructions for generating the foam.

(2) Do not use containers of resin or foaming agent after the dates specified on the container labels by the supplier.

(3) Use only materials supplied by the same insulation supplier and, where that supplier supplies more than one product, ensure that the individual components to be combined are compatible.

(4) Handle all insulation materials in accordance with the supplier's instructions. Keep powdered products dry and free of extraneous materials.

(5) Perform all field quality control checks prescribed by the supplier. At a minimum, perform the following checks at the specified frequencies:

(i) *Setting time (gel time).* Test per Standard for Urea-Formaldehyde Foamed-in-Place Insulation [see § 456.810(8)(e)]. Test before installation each day on each job for each material batch. Check after any change in chemical concentration. Setting time must conform with the supplier's recommendations for the type of structure and procedure being used but shall not exceed 60 seconds nor be less than 20 seconds.

(ii) *Wet density.* Test per Standard for Urea-Formaldehyde Foamed-in-Place Insulation [see § 456.810(e)(4)]. Check the wet density on each new batch of materials, on each new job, and after each down time of at least 45 minutes. Whenever changing from an empty to full container, the density must be retested. The density must also be repetitively tested throughout the foam-making period at a frequency depending on the setting time: for a set time of 20 seconds, check the density at intervals of no more than twenty (20) minutes; for a 60 second set time, check the density at intervals of no more than sixty (60) minutes.

(iii) *Ratio of resin to foaming agent.* Determine the ratio of resin to foaming agent for each batch of materials on each day on each job by measuring the number of gallons of each liquid used.

(iv) *Temperature of liquids.* The temperature of the liquids shall be within the acceptable range specified by the supplier.

(v) *Specific gravity of dilute resin.* Check the specific gravity of each batch of dilute resin with a hydrometer. The tolerance of ± 5.0 percent variance from the supplier's mean value for the supplier specified temperature range shall be acceptable. Do not use materials whose specific gravity is out of range.

(vi) *Water temperature and hardness.* When reconstituting powdered U–F foam components ensure that the water temperature and hardness are within the acceptable ranges specified by the supplier. Maintain a reconstitution record for each batch of material prepared.

(vii) *Uniform cell distribution.* Ensure that the foam is characterized by uniform cell distribution with a cell size not to exceed 1 mm in diameter.

(6) Maintain a record of the results of all field quality control checks and of other pertinent information required by the supplier, including, but not limited to:

(i) Date of application
(ii) Outdoor ambient air temperature
(iii) Material lot number(s)
(iv) Expiration date(s)
(v) Equipment identification number.

(h) *Pre-Installation procedures.* (1) Inspect and identify areas where previous moisture problem has caused paint peeling, warpage, stain, visible fungus growth, rotting, or other structural damage. Do not install insulation in such areas until the resident has been notified and these conditions have been corrected and their sources(s) eliminated. If the resident, after being informed of the moisture condition and the effects of installing insulation in such areas, elects to proceed with the installation, the resident must so state in writing on the contract.

(2) Block all openings in sidewalls through which the insulation material may escape. Seal all wall cavities which open into an attic, basement, or crawl space prior to installing insulation.

(3) For buildings located in Zone I of Figure 1, provide a vapor barrier on the interior surface of all walls to be insulated in bathrooms, and unvented kitchens and laundry areas. Caulk or seal all major cracks on the interior face of exterior walls of these rooms including joints between the floor and wall (except where impractical because of carpeting), between wall and ceiling, at joints around window frames, and around wall penetrations for electrical services (outlets and switches), plumbing stacks, and heating and air-conditioning ducts.

BILLING CODE 6450-01-M

Figure 1. Condensation Zones in the United States

ASHRAE HANDBOOK AND PRODUCT DIRECTORY - 1977 FUNDAMENTALS, Page 20.9

BILLING CODE 6450-01-C

Note 2.—It is recommended that a vapor barrier and caulking, such as described in this section, also be provided on all walls to be insulated in bathrooms and unvented kitchens and laundry areas in buildings in Zone II of Figure 1 in § 456.905.

Note 3.—The above requirements for moisture control are minimum requirements needed to prevent long-term moisture damage. Homes which are characterized by one or more of the following conditions are more likely to experience excessive moisture accumulation which can be corrected by application of a vapor barrier and caulking as described above and/or additional venting of the wall cavity from the exterior or by additional ventilation of the occupied space:

a. Homes with an area of less than 800 sq. ft.

b. Homes with less than 250 sq. ft. per occupant.

c. Homes with tight wall and ceiling construction and weatherstripped windows and doors.

d. Electrically heated homes or homes with a heating system which uses outside combustion air.

A relative humidity indicator may be installed to monitor the humidity level and determine when excessive moisture accumulation is likely to occur.

(4) Determine the material on the interior of outside wall contructions. Do not install U-F foam unless this material has a finish rating of not less than 15 minutes when tested in accordance with ASTM E 119–76.

Note 4.—Some ½ inch gypsum board (dry wall) provides the required finish rating.

Note 5.—Some U-F suppliers do not recommend applying foam directly against certain types of wall coverings. Some wall coverings that should be approached with caution are: knotty pine tongue and groove, wainscoting, colonial inset board paneling, printed wood paneling, and particle board. Check with the supplier prior to installation.

(5) Determine if the structure has dissimilar metals with large surface areas exposed in the same cavity. (Since the foam is wet with mild acidity, rapid electro-chemical corrosion can take place.) Contact the supplier to obtain assistance in the application to such structures.

(6) Inspect window frames. Identify any windows which contain internal mechanisms such as springs, counterbalance weights, friction strips, etc. in their frames. Follow the supplier's specific installation procedures for foaming these areas.

(7) Provide the customer with a statement identifying the effective thermal resistivity of the material to be installed, as determined by the test method in the standard for Urea-Formaldehyde Foamed-in-place Insulation, and a statement identical to that contained on the caution label printed on the U-F resin containers.

(i) *Installation Procedures.* (1) *General.* (i) Do not install insulation unless the pre-installation procedures have been carried out and any defects which were identified have been corrected and their causes eliminated.

(ii) Do not install insulation unless all field quality control and equipment checks required to be performed prior to installation have been completed. Conduct tests as required during the installation.

(iii) Operate all installation equipment in accordance with the equipment manufacturer's instructions.

(iv) Structural damage can be caused by excessive pressure during installation or can result from installing U-F foam insulation in constructions too weak to withstand normal pressures. Assure that installation does not cause the structural failure of the wall construction or its components. Specifically, the following conditions must not result from the installation:

(A) Separation of finish materials from studs

(B) Cracking of materials or opening of joints between boards

(C) Deflection of more than 1/200 of the stud spacing.

(v) Do not install insulation in wall cavities which themselves are air ducts for heating, ventilation, and/or cooling systems.

(vi) Do not install insulation when the atmospheric relative humidity, or outdoor ambient temperature, or cavity temperature is not within the acceptable range specified by the supplier.

(vii) Install insulation only in cavities which will preclude contact by the insulation with the ground or other sources of water.

(viii) Install insulation only between conditioned and unconditioned spaces.

(ix) U–F foam is a combustible material. Install U–F foam so as to meet the applicable requirements listed below in paragraphs (i)(1)(ix) (A) and (B) of this section.

(A) If a wall cavity contains recessed lighting fixtures or other heat producing devices, either provide a three-inch minimum clearance around the recessed lighting fixtures (including wiring compartments and ballasts) and other heat producing devices not covered in paragraph (B) or do not install U–F foam in the cavity containing such heat producing device(s). Do not cover these devices so as to entrap heat or prevent the free circulation of air, unless they are approved for such purpose.

(B) Provide the minimum clearances around gas fired appliances specified in NFPA–54, the National Fuel Gas Code. Around oil-fired applicances, provide the minimum clearances specified in NFPA–31, Standard for the Installation of Oil Burning Equipment. Around masonry chimneys or masonry enclosing a flue, provide a minimum two-inch clearance from the outside face of the masonry. Around vents, chimney and vent connectors and chimneys other than masonry chimneys, provide the minimum clearances specified in NFPA–211, Standard for Chimneys, Fireplaces, and Vents.

(x) Remove any foam which is inadvertently sprayed on glass or exterior siding before drying occurs.

(xi) Open all entry holes with a technique that permits refinishing with little or no change in appearance.

(2) *Frame Walls.* Insulate frame construction walls (including masonry veneer construction) by one of the following two procedures:

(i) Method A. Do not foam cavities in excess of 10 ft in height by this method.

(A) Make an entry hole (fill port) between half and three quarters of the way up the wall. Make the fill port at least ½" larger in diameter than the outside diameter of the hose to allow air relief and maneuvering of the hose.

(B) Probe the cavity for blockages and make additional fill ports as necessary to ensure complete filling of the cavity. For a typical layout of fill ports, see Figure 2.

(C) Insert the applicating hose into the cavity within approximately 2 to 4 inches from the bottom (see Figure 3, Position "A").

(D) Retrieve the hose at a rate approximately equal to the rate of foam dispensation unless the supplier specifically recommends that the hose remain at the extremity of the cavity for the total filling time.

(E) When the foam reaches the level of the fill port repeat the procedure for the upper part of the cavity (see Figure 3, Position "B").

(ii) Method B. This method may be used to foam cavities in excess of 10 ft in height as well as shorter cavities.

(A) For each unobstructed cavity, make at least three entry holes which correspond to the size of the applicating hose (or adaptor, if used). Place the fill ports at approximately 1½ ft from the bottom, 4 ft from the bottom and 1½ ft from the top of the cavity (see Figure 4). A specific air relief hole may also be provided at the very top of the cavity.

BILLING CODE 6450-01-M

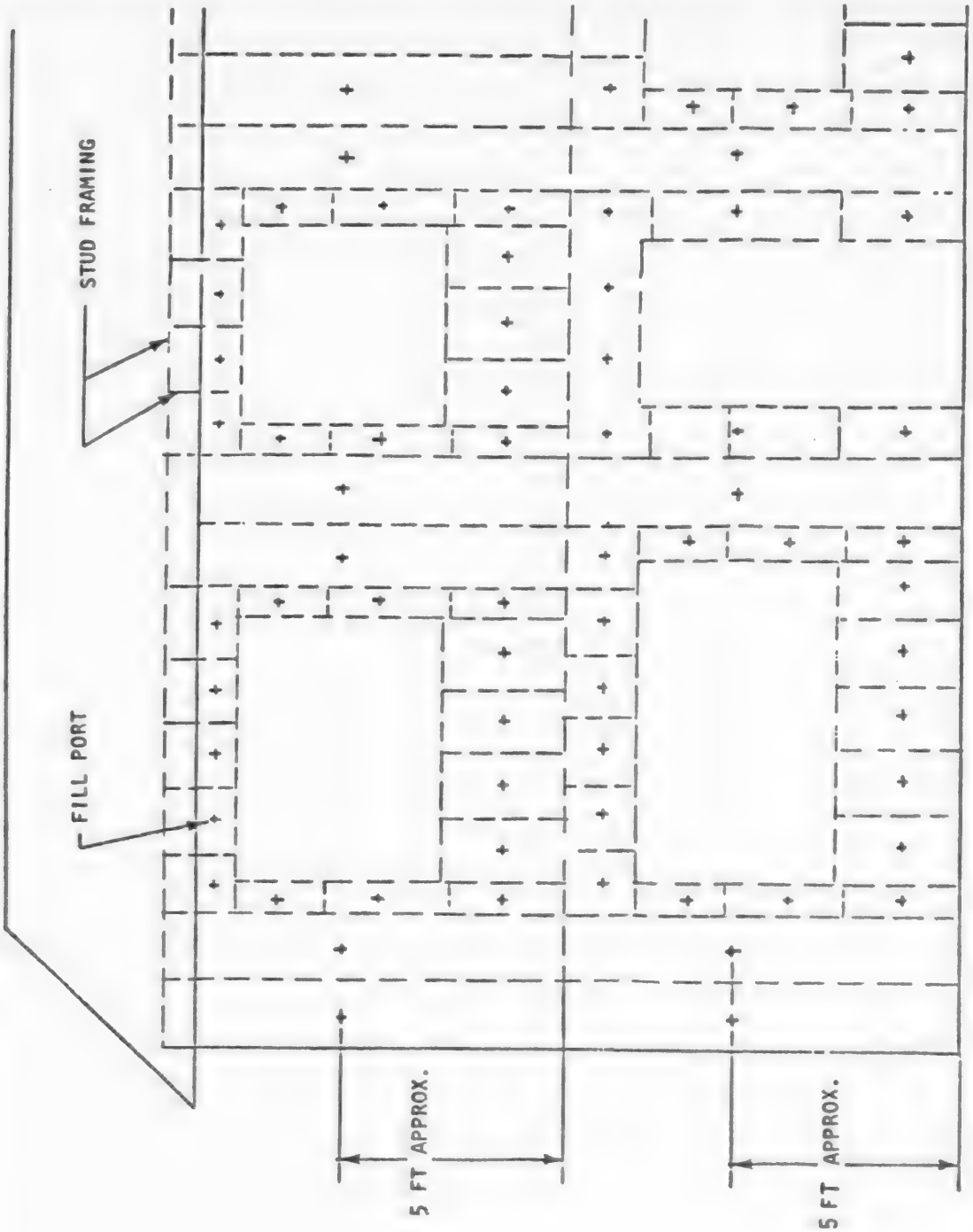

Figure 2. Typical Layout of Fill Ports

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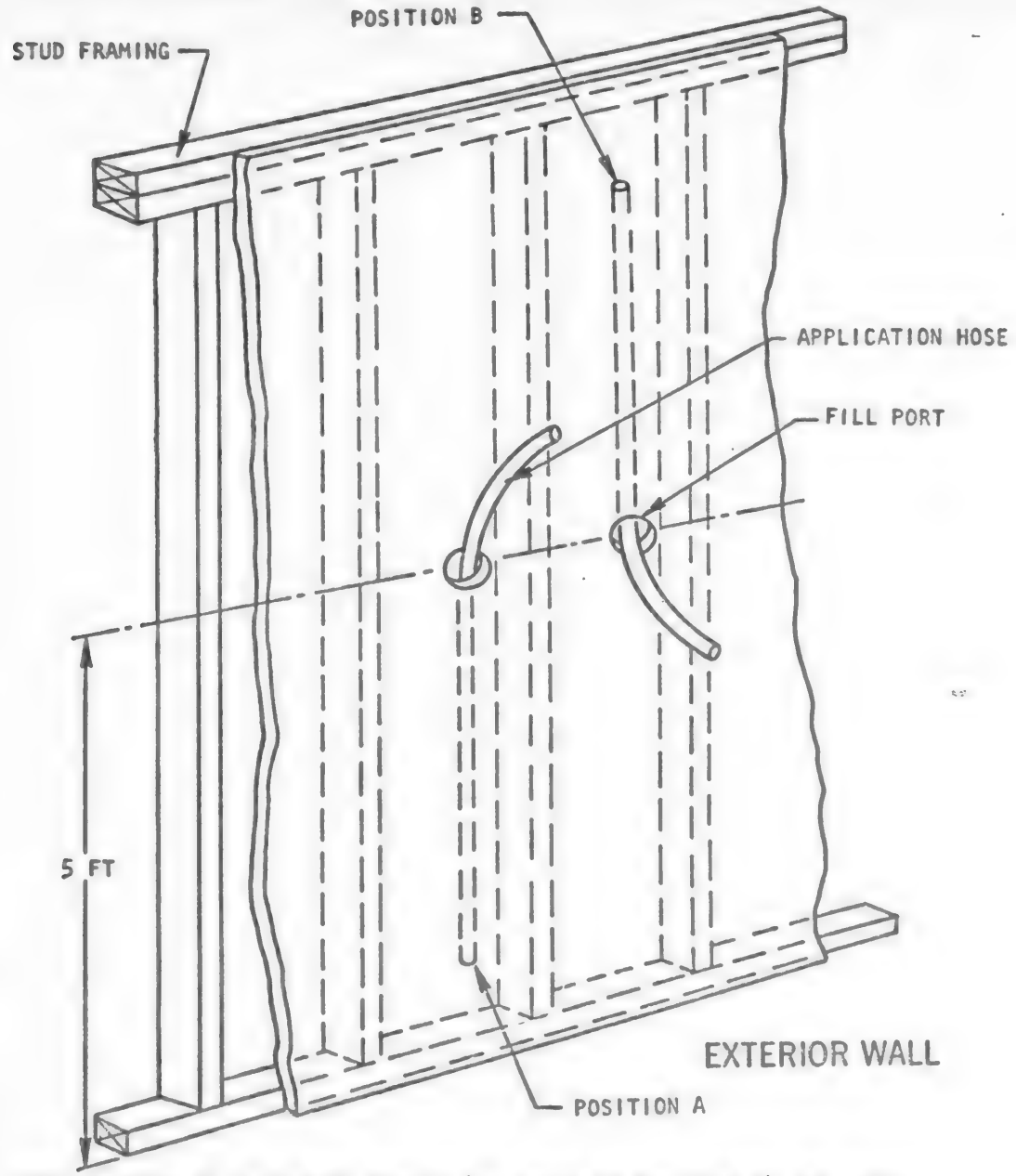

START FOAMING AT BOTTOM OF CAVITY (AS SHOWN IN POSITION A) AND KEEP WITHDRAWING HOSE SLOWLY AS CAVITY FILLS UP. WHEN FOAM STARTS FLOWING OUT OF THE FILL PORT, REVERSE THE HOSE AS SHOWN IN POSITION B AND PROCEED AS BEFORE. CHECK CAVITIES FOR OBSTRUCTIONS (I.E., FIRE STOPS, BLOCKAGES, ETC.) AND DRILL ADDITIONAL FILL PORTS IF NECESSARY.

Figure 3. Insulating Closed Cavities Method A

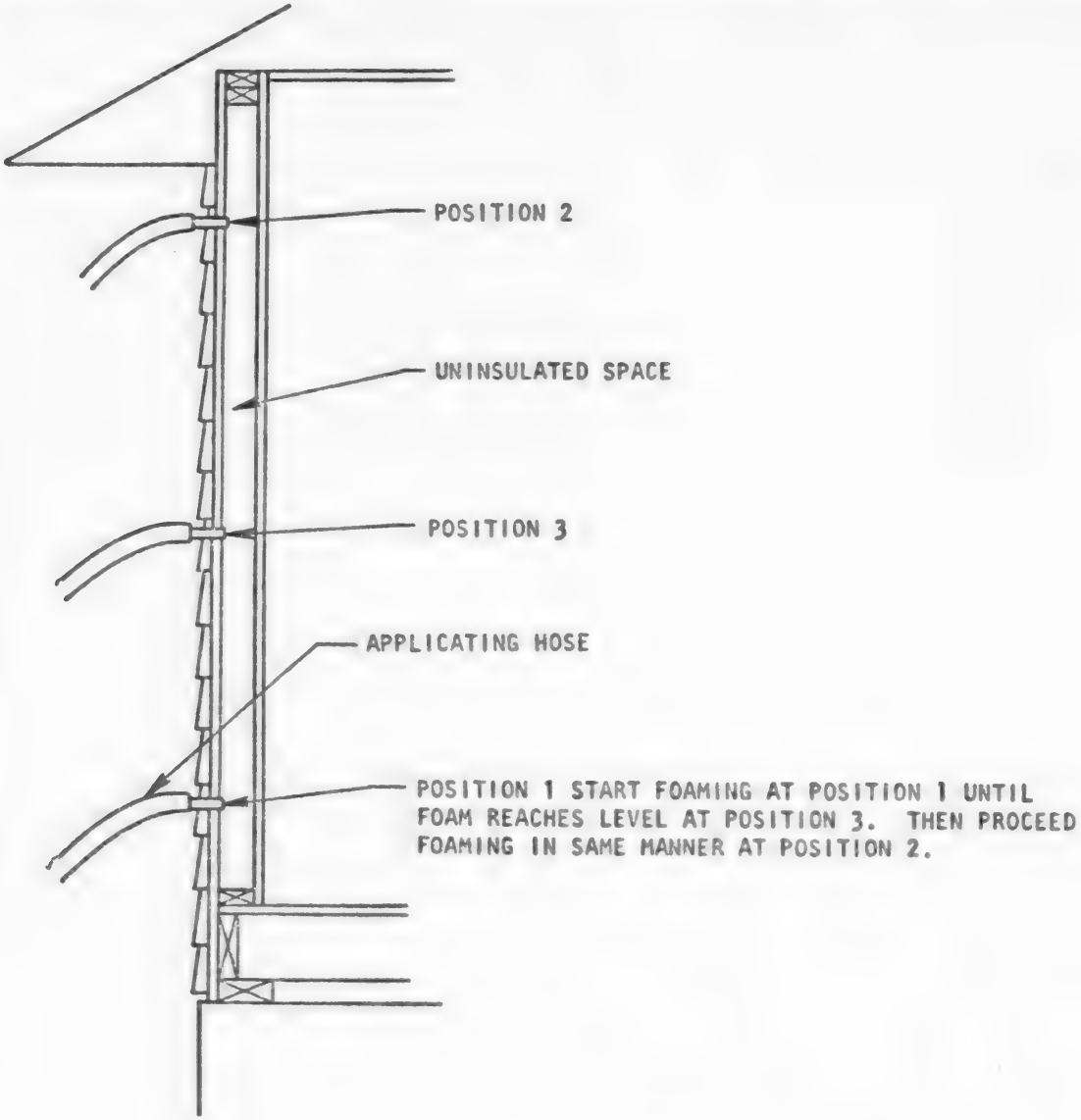
POSITION 2
UNINSULATED SPACE
POSITION 3
APPLICATING HOSE
POSITION 1 START FOAMING AT POSITION 1 UNTIL FOAM REACHES LEVEL AT POSITION 3. THEN PROCEED FOAMING IN SAME MANNER AT POSITION 2.

Figure 4. Insulating Closed Cavities
Method B

(B) Place the applicating hose up to or just inside the bottom fill port and dispense the foam until the next fill port level is reached.

(C) Repeat this procedure by foaming through the top level fill port until foam reaches the center fill port.

(3) Masonry cavity construction (concrete block, brick on brick, brick on block). (i) Do not use this method to foam brick veneer construction. Attempts to fill brick veneer construction by this method may cause buckling, breaking, or other damage to the walls. Brick veneer construction should be foamed in accordance with the instructions for frame construction.

(ii) The internal void area (cavity) in masonry wall constructions usually runs the entire distance of the wall. Provide holes at three foot internals along the horizontal distance of the wall and two foot intervals along the vertical distance of the wall. Begin the bottom-most row of holes at a distance of between one to two feet from the botton of the wall cavity.

(iii) Begin foaming at one of the bottom corners of the wall and continue foaming until foam is detected at the horizontally adjacent hole.

(iv) Ensure that the setting time is longer than the time it took the foam to travel between the horizontal holes.

(v) Move to the adjacent horizontal hole and repeat the procedure specified above.

(vi) After the bottom row has been foamed, proceed to the next row and repeat the procedure until the entire wall has been filled.

(4) *Buildings with metal exterior surfaces.* Buildings with a metal exterior surface require special installation techniques. U–F foam should not be installed in these buildings unless adequate means are provided to allow for moisture and other vapor to escape to the outside. Follow the supplier's instructions for application to these types of structures.

(5) *Window-Door Frames.* (i) Do not apply U–F foam to the frames until after the walls have been insulated.

(ii) Drill entry holes which correspond to the size of the applicating hose (or adapter, if used) into the void areas around the frames. Drills holes into the facia of the frame wherever possible.

(iii) Foam each entry hole until foam appears at the adjacent hole or until foam emerges from cracks in and around the moldings.

(iv) If the window has any moving parts within the space to be insulated, work the mechanism of the closure. For a fast setting time (20 seconds) work the mechanism within 15 minutes of filling. For a slow setting time (90 seconds) work the mechanism within 30 minutes of filling. This procedure will ensure that the interior mechanisms of the unit remain operative.

(j) *Post-installation procedures.* (1) Seal all entry holes on the exterior of the wall system in a manner compatible with the original materials and appearance but only after a minimum of 72 hours following the completion of foaming to allow for the egress of gases and moisture. Seal all entry holes on the interior of the wall system immediately following the completion of foaming.

(2) Determine if many coats of paint or caulking have created an impermeable vapor barrier. Take corrective measures, such as loosening up the siding, removing caulking between wood laps, or installing vents/diffusers, to eliminate the vapor barrier and allow curing to take place. Ensure that the venting provided does not result in rain water leakage into the wall system.

(3) Inspect the interior of electrical wall outlet boxes and other electrical devices and, where necessary, remove any insulation which entered during the foaming process. Ensure that electrical power has been turned off prior to conducting this procedure.

(4) Ensure that windows and doors operate properly.

(5) Ensure that any insulation which has come in contact with glass, aluminum, or vinyl building components or has otherwise permeated the interior of the residence has been cleaned off.

(6) Offer the customer a sample of the foam installed at the customer's premise, at no cost to the customer, which is approximately the size required for the dry density test, packaged in a manner to prevent deterioration for at least three years.

§ 456.914 Standard practice for the installation of electrically operated, mechanically actuated and thermally actuated automatic vent dampers for use with gas-fired central furnaces and low-pressure hot-water boilers.

(a) *Scope.* (1) This practice is intended as an aid to safely installing electronically-operated, mechanically-actuated and thermally-actuated, automatic vent dampers on existing appliances. A safe installation requires knowledge and equipment that may be possessed only by qualified installers. (A qualified installer is a person who has specialized training and a working knowledge of the applicable codes and regulations, tools, equipment, and methods necessary for the safe installation of automatic vent dampers for gas-fired applicances and the necessary understanding of the fundamentals of gas-fired heating systems (see § 456.314)). *An improper installation could result in injury or death* during installation or at a later date from such hazardous conditions as electrical shock or the venting of exhaust gases, including carbon monoxide, into the residence. This practice outlines general procedures to be followed, but leaves the detailed step-by-step procedure to the qualified installer. Generalized procedures cannot anticipate all situations. Accordingly, in some cases, deviation from this procedure may be necessary for a safe installation. For this reason, *only qualified installers should perform the installation.*

(2) A safe installation requires that safe vent damper and heating appliance designs be used. Therefore, the vent damper and heating applicance designs must, as a minimum, meet the appropriate nationally recognized standard requirements. These are ANSI Z21.66–77, American National Standard for Electrically-Operated Automatic Vent Dampers Devices for Use with Gas-fired Appliances; ANSI Z21.67–1978, American National Standard for Mechanically-Actuated Automatic Vent Damper Devices for Use with Gas-Fired Appliances; ANSI Z21.68–1978, American National Standard for Thermally-Actuated Automatic Vent Damper Devices for Use with Gas-Fired Appliances; ANSI Z21.13, American National Standard for Gas-Fired Low Pressure Steam and Hot Water Boilers; ANSI Z21.47, American National Standard for Gas-Fired Gravity and Forced Air Central Furances.

Note 1.—Often the authority having jurisdiction over the installation of gas equipment in a locality will have requirements that must be met before equipment is considered safe and is approved for use in that locality. Often equipment must be listed before it is approved. Listed equipment is that included in a list published by a nationally recognized testing laboratory that maintains periodic inspection of the production of equipment that it lists. Each listing states the equipment either meets nationally recognized standards or has been tested and found suitable for use in a specified manner. Listed vent dampers and heating appliances are intended to include only safe designs. Using a listed vent damper on a listed heating appliance does not necessarily imply a safe retrofitted system, however. Not all listed vent dampers are compatible with all listed heating appliances. In addition, the safety of a retrofitted system depends not only on the safe designs of the existing heating appliance and vent damper but also on the manner in which the vent damper is installed.

(3) The installer shall ensure that mechanically-actuated vent dampers are only installed on appliances where the specific interconnection diagrams

between the motive force and control circuits and the heating appliance supplied by the vent damper manufacturer show the device to be compatible with the appliance. Electrically-operated vent dampers and thermal vent dampers with electrical connections shall only be installed on appliances where the specific wiring diagrams supplied by the vent damper manufacturer show the device to be compatible with the appliance. If a wiring or interconnection diagram is not supplied by the vent damper manufacturer which duplicates the heating system on which the installation is desired, the installation must not be attempted.

(4) This practice is intended only for use with individual, automatically operated, gas-fired, hot-air (forced or gravity) furnaces and low-pressure, hot water boilers equipped with draft hoods.

(5) Because vent dampers save energy by reducing heated air flow up the vent during periods when the main burner of the heating appliance is off, do not install vent dampers in areas that are essentially at outdoor temperatures, such as unheated basements, attics, or crawl spaces.

(6) Because vent capacities are reduced when the difference between indoor and outdoor temperatures are the least, and, generally, when wind velocities are low, all checks of venting capacity or draft hood spillage must be conducted when the outside temperature is above 65°F and the wind velocity is less than 10 MPH. Venting may be particularly dependent on wind conditions in certain special situations. Extra caution must be exercised in these special situations that include exposed locations in high wind areas; locations in very hilly terrain; difficult constructional features for venting purposes, such as high pitched roofs; and neighborhoods with sharply varying building heights. In these situations, wind currents directed at the top of the chimney may cause downdrafts at times. If any of these situations are suspected of causing draft problems, it will be necessary to conduct the vent capacity or draft-hood spillage checks on several days under various conditions.

(7) At any point, if it is determined that there is a condition that could result in unsafe operation of the heating system, the appliance must be shut off, the owner informed of the required repairs, and the repairs made before continuing with the installation.

(8) This practice requires the following items be followed in order:

(i) Pre-Installation Procedure in paragraph (b)

(ii) General Installation Procedure in paragraph (c)

(iii) Post-Installation Procedure in paragraph (d)

(b) *Pre-installation procedure.* (1) This pre-installation procedure is to determine whether a gas heating appliance is properly installed and is in a safe condition for continuing use. Perform this procedure before making any attempt to install a vent damper, and do not install a vent damper on an appliance if the determinations required below cannot be made.

(2) Determine with suitable instruments, in the vicinity of the heating appliance, that the concentration of combustible gas is less than 20 percent of the lower explosive limit and that carbon monoxide is less than 50 ppm.

(3) Determine that the heating system meets the requirements of all applicable codes and regulations. The heating system should at least meet the requirements of the American National Standard Fuel Gas Code, ANSI Z223.1–1974 (NFPA No. 54–1974) Part 1, Installation of Gas Piping and Gas Equipment on Nonindustrial Premises.

(4) Conduct a gas leakage test of the appliance piping and control system downstream of the shutoff valve in the supply line to the appliance. *Do not* use a flame or other source of ignition to check for gas leaks.

(5) Inspect the venting system to determine that the cross-sectional area of the vent connector is not less than the area of the draft-hood outlet (the chimney side of the draft-hood) and that the area of the vent is not less than the area of the largest, connected, draft-hood outlet plus 50 percent of the areas of additional connected, draft-hood outlets. If these criteria are not met, the vent system must be in accordance with the National Fuel Gas Code (ANSI Z223.1–1974) paragraphs 1.5.5.3 and 1.5.8.3. Determine that there are no manually adjustable dampers in the vent system. Also visually inspect for positive horizonal pitch (not less than ¼ inch/foot) and determine that there is no blockage, restriction, leakage, corrosion, etc., which could cause an unsafe condition.

(6) Determine that the outside termination of the vent is satisfactory (See National Fuel Gas Code, ANSI Z223.1–1974, 1.5.5.2 and 1.5.6.3). Determine that the chimney is unobstructed, does not have excessive soot buildup, is in good condition, and is either a lined masonry chimney or an approved Type B or Type L vent. Do not install a vent damper in a heating system using any other chimney type, including unlined masonry chimneys and uninsulated, single-wall metal pipes. Determine that the vent connector does not project into the chimney.

(7) Determine that the comfort thermostat(s) is in satisfactory operating condition. Check for excessive dust, corrosion, pitted contacts, and cracked or broken base or housing. Note the comfort thermostat setting so it can be reset after the installation is completed. Then adjust the thermostat for continous operation. Determine that the burner input is in accordance with the heating appliance manufacturer's instructions.

(8) Visually determine that the main burner gas is burning properly and that there is no floating, lifting, or flashback. Adjust the primary air shutter(s) as required. If the appliance is equipped with flame modulation, check for proper main burner operation at low and high flame. Observe burning for evidence of plugged burners, improper flame alignment, combustion product leakage, and improperly adjusted pilot lights.

(9) Shut off all gas to the appliance using the shutoff valve in the supply line to the appliance. Shut off the main burners of all other appliances located within the same room or connected to the same vent. Note the settings of any thermostats that are to be changed so they can be reset after the installation is completed.

(10) Determine that there is sufficient combustion air. In unconfined spaces in buildings of conventional frame or masonry construction, infiltration normally is adequate to provide air for combustion, ventilation, and dilution of flue gases. If the unconfined space is within a building of unusually tight construction, air must be obtained from outdoors or from spaces freely connected with outdoors. Permanent openings having a total free area of not less than one square inch per 5,000 Btu/hr of total input rating of all appliances must be provided. For appliances located within confined areas, follow the recommendations of the National Fuel Gas Code (ANSI Z223.1–1974) paragraphs 1.3.4.3 through 1.3.4.6. Check any ducts for obstructions and other unsafe conditions.

(11) Determine that all electrical wiring at the appliance has no loose connections, charred insulation, cracked or worn insulation, and potential shorting to ground. Determine that fuses and circuit breakers are of correct size and that wires are of correct size for the appliance.

(12) Determine that appliance burners and gas manifolds are not blocked or corroded. Determine that burner alignment will not cause hot spots on the heat exchanger.

(13) *Applicable only to furnaces:* Determine that the heat exchanger has no cracks, openings, leakage deposits, excessive corrosion, and evidence of excessively hot spots. Determine that the recirculating air section of the appliance has no flammable materials or materials that could emit toxic fumes on being heated.

(14) *Applicable only to boilers:* Determine that there is no evidence of water or combustion product leaks.

(15) Insofar as is practical, close all building outside doors and windows. Turn on all exhaust fans (range hood, bathroom exhausts, etc.) so they will operate at maximum speed. Turn on any clothes dryers vented to the outside. Do not operate summer exhaust fans. Make certain that any fireplace(s) is not operating. Close fireplace dampers.

(16) For the following vent system checks, the worst venting conditions that may reasonably exist should be duplicated. The worst venting conditions exist when the space occupied by the heating appliance is at the lowest pressure. If there are exhaust fans in the same room as the heating appliance or if there are no exhaust fans in the residence, the lowest pressure will probably occur when the doors to other spaces of the building are closed. If there are exhaust fans in other rooms, the pressure will probably be lowest when doors connecting these rooms with the heating appliance space are open. Based on these considerations, open or close doors to other spaces of the building as required to produce the lowest pressure in the space occupied by the heating appliance. If it is not known which condition results in the lowest pressure, perform paragraphs 16 through 20 twice—once with doors to other spaces of the building open and once with the doors closed. After the appliances have been off for at least 30 minutes, turn on the gas to the appliance being inspected and place it in operation. *Follow the manufacturer's lighting instructions.* Adjust the comfort thermostat for continuous, full-burner appliance operation.

(17) Test for spillage at the draft hood relief opening at 2 minutes of main burner operation. This short time is necessary to simulate a reasonably severe test. Use a device that will produce unpressurized flame or smoke, such as a match flame or cigarette smoke. Considerable care must be used to determine if flow is in or out of the draft-hood.

Adequate lighting must be provided for observation and the flow around the whole opening must be carefully observed. After testing for spillage at the heating appliance draft-hood, also test for spillage at other draft-hoods connected to the same vent.

(18) Shut off the main burner and let the appliance cool for at least 15 minutes.

(19) Turn on all other fuel-burning appliances that are within the same room or that are connected to the same vent so they will operate at their full inputs. Turn on the appliance being inspected so that it will operate at its full rated input.

(20) Repeat paragraph (17).

(21) At 5 minutes of main burner operation, measure the flue gas temperature and carbon monoxide (CO) concentration at a point one inch before the inlet to the draft-hood at the center of the flue passage(s). This temperature should be at least 200°F. This temperature is necessary to limit condensation within the vent. This temperature should also be less than 550°F, the vent damper maximum design temperature. The maximum carbon monoxide concentration should be 0.04 percent (400 ppm), as permitted for new heating appliances.

(i) *For thermally-actuated vent dampers only:* Measure the temperature at the center of the vent connector six inches after the outlet of the draft hood. The vent gas temperature must be at least 370°F but less than 550°F. This is the temperature at which the damper design has been tested for flow restriction. If the appliance is equipped with flame modulation, rerun the minimum (200°F) flue gas temperature test, the 370°F vent gas temperature test, and the CO test at the lowest flame conditions.

(ii) *For electrically-operated and mechanically-actuated vent damper only:* If the vent damper is not installed with a redundant gas valve, it must be installed with a damper-closing temperature control, and the temperature at the center of the vent connector six inches after the outlet of draft-hood must be measured. This damper-closing temperature control is intended to keep the damper open if the main burner is operating. The vent gas temperature must be more than 375°F to properly actuate the damper-closing temperature control. If this temperature is not above 375°F, do not install a vent damper with a damper-closing temperature control. If the appliance is equipped with flame modulation, rerun the minimum (200°F) flue gas temperature test and the CO test at the lowest flame conditions.

(22) Return doors, windows, exhaust fans, fireplace dampers, and other appliances to their previous conditions of use.

(23) Determine that the pilot(s) is burning properly and that main burner ignition is satisfactory by turning the main power supply switch for the heating appliance off and on. Test the pilot safety device to determine if it is operating properly by extinguishing the pilot burner(s) when the main burner is off and determine that the main gas valve does not open upon a call for heat beyond the safety shut-off time specified by the automatic gas ignition device manufacturer. If this time is not known, a safety shut-off time of one minute must be met. Relight the pilot(s) after this time check.

(24) *Applicable only to furnaces:* Check both the limit control and the fan control to determine that they operate within the heating appliance manufacturer's specifications.

(25) *Applicable only to boilers:* Test low-water cutoffs, automatic-feed controls, high-pressure limit controls, high-temperature-limit controls, relief valves, water pumps, and the circulating system to determine that they are operating within the manufacturer's specifications.

(c) *General installation procedure.* (1) This general installation procedure is to be used in conjuction with installation instructions supplied by the automatic vent damper manufacturer to aid in safely installing a vent damper on an existing appliance. At any point, if it is determined that there is a condition that could result in unsafe operation of the heating system, the appliance must be shut off, the owner informed of the necessary repairs, and the repairs made before continuing with the installation.

(2) Ensure that the manufacturer has supplied specific interconnection or wiring diagrams for the appliance on which the damper is to be installed. Determine that the heating system and vent damper are approved models. Ensure lack of damage in shipping or other obvious damage and ensure that all parts are included. Determine if the vent damper includes a damper-closing temperature control. If the vent damper has a damper-closing temperature control, ensure that the heating appliance control circuit is of sufficient voltage. *For Mechanically-Actuated Vent Dampers Only:* Determine that the range of available motive force (gas pressure, water pressure, etc.) is within the vent damper manufacturer's specified operating range. Determine that the heating appliance automatic gas valve does not have a manual override feature that would permit manual operation of the heating appliance while the damper remains closed.

(3) Shut off all gas and electricity to the heating appliance. *To shut off the*

gas, use the shut-off valve in the supply line to the appliance. To shut-off the electricity, use the main power switch for the heating appliance.

(4) Install the automatic vent damper in strict accordance with the manufacturer's installation instructions. Make certain that the damper is located in that portion of the venting system that serves only the appliance on which the damper is being installed and that it is between the appliance and the first branch (if any) in the vent system. The vent damper must be installed *after* the draft hood, that is, between the draft hood and the chimney. If the damper is equipped with a damper-closing temperature control, the damper must be located within three diameters of the draft hood. The inlet size of the vent damper must not be less than the outlet size of the draft hood. *Do not add any components (such as relays) not specified by the manufacturer.*

(5) Determine that the vent system is adequately supported to hold the additional weight of the vent damper without sagging. This may require band iron straps attached overhead and/or self-tapping screws at each joint. Visually inspect the modified venting system for proper horizontal pitch (not less than ¼ inch/foot).

(6)(i) *For installation of thermally-actuated vent dampers only:* An additional approved automatic gas valve must be installed in accordance with the vent damper manufacturer's installation instructions. This gas valve is intended to shut off gas flow if the other gas valve should stick open, particularly partially open. At reduced gas flow resulting from a partially open gas valve, the vent gas temperature would be reduced and the damper may not open sufficiently to prevent spillage. The additional gas valve may be either an additional valve (without pilot features) located in the gas line between the existing valve and the main burner or a replacement valve that includes two main gas valves within a single unit. Follow the vent damper manufacturer's instructions for installation. After installing a new gas valve, purge air from the effected gas lines and conduct a gas leakage test of the appliance piping and control system down stream of the shut-off valve in the supply line to the appliance.

(ii) *For installation of electrically-operated or mechanically-actuated vent dampers only:* If the vent damper is not equipped with a damper closing temperature control, an additional approved automatic gas valve must be installed in accordance with vent damper manufacturer's installation instructions. This gas valve is intended to shut off gas flow if the other gas valve should stick open. It may be either an additional valve (without pilot features) located in the gas line between the existing valve and the main burner or a replacement valve that includes two main gas valves within a single unit. Follow vent damper manufacturer's instruction. After installing a new gas valve, purge air from the effected gas lines and conduct a gas leakage test of the appliance piping and control system downstream of the shut-off valve in the supply line to the appliance.

(7) Make sure electrical connections are tight and wires are clear of high-temperature locations and properly supported. Route wires to minimize the possibility of their being damaged. All wiring must meet the requirements of all applicable codes and regulations. As a minimum, wiring must meet the requirements of the National Electrical Code, NFPA 70–1975.

(d) *Post-installation Procedure.* (1) This post-installation procedure is to determine that an automatic vent damper is properly installed and that the retrofitted system is in a safe condition for use. At any point, if it is determined that there is a condition that could result in unsafe operation of the heating system, the appliance must be shut off, the owner informed of the necessary repairs, and the repairs made before continuing.

(2) Turn on electrical power to the heating appliance.

(3) *For the installation of electrically-operated and mechanically—actuated vent dampers only:* By operating the furnace burner through the control circuit, determine that the damper operates properly and is correctly sequenced with the heating applicance's operating controls. The damper should be nearly open *before* the gas valve(s) opens and it should remain open when there is a call for main burner operation. The gas valve(s) should close when the damper *begins* to close and should remain closed when there is no call for heat. The damper must open and close freely without evidence of interference or binding. Also determine that the damper closes fully.

Note.—If a boiler gas valve(s) is sequenced by an aquastat, determine that the damper is nearly open prior to the opening of gas valve(s).

(4) If the damper has electrical current requirements, determine the amperage draw of the gas control circuit (including such items as thermostats, humidifiers, controls for electronic filters, etc.) and the vent damper. Check the appliance transformer for adequate capacity. If the transformer does not have adequate capacity, it must be replaced.

(5) Check the setting of any heat anticipator in the comfort thermostat and readjust as necessary.

(6) Insofar as is practical, close all building outside doors and windows. Turn on any exhaust fans (range hood, bathroom exhausts, etc.) so they will operate at maximum speed. Turn on any clothes dryers vented to the outside. Do not operate summer exhaust fans. Make certain that any fireplace(s) is not operating. Close fireplace dampers.

(7) (i) *For Installation of thermally actuated vent dampers only:* For the following vent system checks, the worst venting conditions that may reasonably exist should be duplicated. The worst venting conditions exist when the space occupied by the heating applicance is at the lowest pressure. If there are exhaust fans in the same room as the heating applicance or if there are no exhaust fans in the residence, the lowest pressure will probably occur when the doors to other spaces of the building are closed. If there are exhaust fans in other rooms, the pressure will probably be lowest when doors connecting these rooms with the heating applicance space are open. Based on these considerations, open or close doors to other spaces of the building as required to produce the lowest pressure in the space occupied by the heating appliance. If it is not known which condition results in the lowest pressure, perform paragraphs 6 through 8 twice—once with doors to other spaces of the building open and once with doors closed.

After the appliances have been off for at least 30 minutes, turn on the gas to the applicance on which the damper has been installed and place the applicance in operation. Follow the *manufacturer's lighting instructions.* Adjust the comfort thermostat for continuous full burner appliance operation.

(ii) *For installation of electrically-operated and mechanically-actuated vent dampers only:* Turn on the gas to the heating appliance and place it in operation. *Follow the manufacturer's lighting instructions.* Adjust the comfort thermostat for continuous, full-burner operation.

(8) Test for spillage at the draft hood relief opening at 2 minutes of main burner operation. This short time is necessary to simulate a reasonable severe test. Use a device that will produce unpressurized flame or smoke, such as a match flame or cigarette smoke. Considerable care must be used to determine if flow is in or out of the draft hood. Adequate lighting must be provided for observation and the flow

around the whole opening must be carefully observed.

(9) *For thermally—actuated vent dampers only:* If the appliance is equipped with flame modulation, repeat paragraphs 6 and 7 at the lowest flame conditions.

(10) Visually determine that main burner gas is burning properly and that there is no floating, lifting, or flashback. If the appliance is equipped with flame modulation, determine that proper main burner operation at low and high flame is maintained.

(11) Determine that the pilot(s) is burning properly and that main burner ignition is satisfactory by turning the main power supply switch for the heating appliance off and on. Test the pilot safety device to determine that it is operating properly by extinquishing the pilot burner(s) when the main burner is off and determining that the main gas valve does not open upon a call for heat beyond the safety shut-off time specified by the automatic gas ignition device manufacturer. If this time is not known, safety shut-off time of one minute must be met. Relight the pilot(s) after this check.

(12) (i) *For thermally-actuated vent dampers only:* Cycle the heating appliance through at least three normal operating cycles. The *damper must open and close properly without evidence of interference or binding.* Determine that the damper closes fully. The damper may not close immediately with the thermostat but after a period of time, it should close.

(ii) *For electrically operated and mechanically-actuated vent dampers only:* Cycle the heating appliance through at least three normal operating cycles. Determine that the damper is nearly fully open *before* the main burner gas flow begins and that the main burner gas flow stops as the damper *begins* to close. Damper must open and close freely without evidence of interference or binding. The damper must close fully. If the vent damper includes a damper-closing temperature control, the damper may not close immediately with the thermostat. Test this by operating the heating appliance for 10 minutes. Then reduce the comfort thermostat to shut off the main burner gas flow. The damper should remain open for a period of time and then close.

If the heating appliance is equipped with flame modulation and the vent damper includes a damper-closing temperature control, operate the heating appliance for 10 minutes at the lowest flame conditions. Then reduce the comfort thermostat to shut off the main burner gas flow. The damper should remain open for a period of time and then close.

(13) *Applicable only to furnaces:* If the furnace electrical circuit has been modified during vent damper installation, check both the limit control and the fan control to determine that they operate within the heating appliance manufacturer's specifications.

(14) *Aplicable only to boilers:* If the boiler electrical circuit has been modified during vent damper installation, test low-water cutoffs, automatic-feed controls, high-temperature-limit controls, water pumps, and the circulating system to determine that they are operating within manufacturer's specifications.

(15) *For thermally-actuated vent dampers only:* Return doors, windows, exhaust fans, fireplace dampers, other appliances, and comfort thermostat(s) to their previous conditions of use.

(16) Fill in a label with the installer's name and address and the date of the installation, and apply to the vent damper.

(17) Complete the verification-of-installation card supplied by the vent damper manufacturer pursuant to § 456.814 and return this to the manufacturer.

(18) Leave the vent damper manufacturer's instructions in a conspicuous location near the heating appliance and advise the resident to read these instructions, especially for observations to be performed by the resident.

(19) As required by codes and regulations, notify the appropriate authority that the installation has been completed and turn off the heating appliance until any required inspection is completed.

§ 456.915. Standard practice for the installation of automatic intermittent pilot ignition devices (IID's).

(a) *Scope.* This practice provides minimum requirements for the installation of IID's for gas-fired furnaces.

(b) *Requirements.* Installations shall meet the requirements of Proposed American National Standard for Automatic Intermittent Pilot Ignition Systems for Field Installation, September 11, 1979.

§ 456.916 Standard practices for the installation of caulks and sealants.

(a) *Scope.* (1) These practices apply to the on-site installation of caulks and sealants used to control rain water leakage and major air infiltration through building walls.

(2) These practices do not apply to the sealing of minor cracks at the building's exterior.

(b) *Material selection, joint preparation, and installation procedures.* (1) the type of caulk or sealant chosen for a given application depends on the composition of the adjacent materials, temperature fluctuation, exposure to direct sunlight, width and depth of the crack or joint to be sealed and movement in the joint. Select caulks and sealants, prepare the joint and substrata, and install the material in comformance with the following standards and provisions:

(i) Putty and Oil and Resin Base Types: ASTM C–797–75, Standard Recommended Practices and Terminology for Use of Oil- and Resin-Based Putty and Glazing Compounds.

(ii) Acrylic (Solvent Type) and Butyl Rubber: ASTM C–804–75, Standard Recommended Practices for Use of Solvent-Release Type Sealants.

(iii) Latex Sealing Compounds: ASTM C–790–74, Standard Recommended Practices for Use of Latex Sealing Compounds.

(iv) Chlorosulphonated Polyethylene, Polysulfide-Single Component, Polysulfide-Multicomponent, Polyurethane-Single Component, Polyurethane-Single Component, Polyurethane-Multi-Component and Silicone: Follow the provisions relating to application and use included in the applicable Federal Specifications (see Table 3, § 456.812).

3. It is proposed to amend paragraph (d) in Appendix II to Part 456 by adding additional standards to those approved on November 1, 1979 and which are shown in the table below preceded by an asterisk.

Appendix II to Part 456—Standard Incorporated by Reference

(a) Incorporation by reference of material and installation standards. The material and installation standards identified herein are hereby incorporated by reference into this Part as though set forth in full herein, pursuant to 5 U.S.C. § 552(a).

Incorporation by reference of material and installation standards in 10 CFR Part 456 was approved by the Director of the Federal Register, November 1, 1979 and ————.

(b) Statement of availability.

(1) Copies of the following standards may be obtained at the following addresses:

• American National Standards Institute (ANSI), 1430 Broadway, New York, New York 10018; except that the "Proposed American National Standard for Automatic Intermittent Pilot Ignition

Systems for Field Installations" may be obtained from Mr. F. G. Hammaker, Administrative Secretary, 721 American Materials Standard Committee, 8501 E. Pleasant Valley Road, Cleveland, Ohio 44131; (216) 524–4990.

• American Society of Testing and Materials (ASTM), 1910 Race Street, Philadelphia, PA 19103.

• National Fire Prevention Administration (NFPA), 470 Atlantic Avenue, Boston, MA 02210

• Environmental Protection Agency (EPA), Washington, DC

• U.S. Department of Commerce, National Bureau of Standards (NBS), Washington, DC 20234.

• Building Officials and Code Administrators (BOCA), International, Inc., 17926 S. Halsted St., Chicago, IL 60430.

• Underwriters Laboratory (UL), 208 E. Ohio Street, Chicago, IL 60611.

• Fir and Hemlock Door Association (FHDA), Yeon Building, Portland, OR 97204.

• Superintendent of Documents, Government Printing Office (GPO), Washington, DC 20402.

• Department of Housing and Urban Development (HUD), Office of Technical and Credit Standards, Room 6156, 451 Seventh Street, SW, Washington, DC 20410

• Sandia Laboratory, Environmental Research Division—5333, Albuquerque, NM 87185.

• Consumer Product Safety Commission (CPSC), 1750 K Street NW, Washington, DC

(2) Copies of all standards incorporated by references are available for inspection in the DOE Reading Room, Room GA–152, Forrestal Building, 1000 Independence Avenue, SW, Washington, DC between the hours of 8:00 a.m. and 4:30 p.m., Monday through Friday.

(c) Changes in material and installation standards. Any change to any material or installation standard will be made in accordance with statutory requirements for notice and public comment and with DOE policy for the adoption of rules. Notice of any proposed change will be published in the Federal Register and reflected as an amendment to the table in paragraph (d).

(d) Table of Standards incorporated by reference.

Table of Standards

Number	Title	Date approved	Section reference
ANSI:			
ANSI/AAMA 1002.9–1977	"Voluntary Specification for Aluminum Combination Storm Windows for External Applications".	Nov. 1, 1979	§ 456.813.
ANSI/AAMA 1102.7–1977	"Voluntary Specifications for Aluminum Storm Doors"	Nov. 1, 1979	§ 456.813.
*ANSI/ASTM B 152–79	"Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar"		§ 456.810.
*ANSI/ASTM B 446–75	"Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloy (UNSO6625) Rod and Bar".		§ 456.810.
ANSI/ASTM D 2156–65 (1975)	"ANSI Standard Method of Tests for Smoke Density in the Flue Gases from Distillate Fuels".	Nov. 1, 1979	§ 456.913.
ANSI Z21.13–1977	"Gas-fired Low Pressure Steam and Hot Water Heating Boilers"	Nov. 1, 1979	§ 456.814 and § 456.914.
ANSI Z21.20–1975	"ANSI Standard for Automatic Gas Ignition Systems and Components"	Nov. 1, 1979	§ 456.814.
ANSI Z21.47–1978	"ANSI Standard for Gas-fired Central Furnaces"	Nov. 1, 1979	§ 456.814 and § 456.914.
ANSI Z21.59–1974	"Gas-fired High Pressure Steam and Hot Water Heating Boilers"	Nov. 1, 1979	§ 456.814.
ANSI Z21.66–1977	"ANSI Standard for Electrically-Operated Automatic Vent Damper Devices for Use with Gas-fired Appliances".	Nov. 1, 1979	§ 456.814 and § 456.914.
ANSI Z21.67–1978	"ANSI Standards for Mechanically-Actuated Automatic Vent Damper Devices for Use with Gas-fired Appliances".	Nov. 1, 1979	§ 456.814 and § 466.914.
ANSI Z21.68–1978	"ANSI Standard for Thermally-Actuated Automatic Vent Damper Devices for Use with Gas-fired Appliances".	Nov. 1, 1979	§ 456.814 and § 456.914.
ANSI Z91.2–1976	"Performance Requirements for Automatic Pressure Oil Burners of the Mechanical Draft Type".	Nov. 1, 1979	§ 456.814 and § 456.913.
ANSI Z96.1–1976/UL 727	"Oil-fired Central Furnaces"	Nov. 1, 1979	§ 456.814.
ANSI Z96.2–1974/UL 296	"Oil Burners"	Nov. 1, 1979	§ 456.814.
ANSI Z96.3–1975/UL 726	"Oil-fired Boiler Assemblies"	Nov. 1, 1979	§ 456.814.
*ANSI Z223.1–1974	"Installation of Gas Piping and Gas Equipment on Non-industrial Premises		§ 456.812 and § 456.914.
ANSI/NWMA I.S. 2–73	"Industry Standard for Wood Windows"	Nov. 1, 1979	§ 456.813.
ANSI/NWMA I.S. 5–73	"Ponderosa Pine Doors"	Nov. 1, 1979	§ 456.813.
ASTM:			
*ASTM C–177–76	"Standard Test Method for Steady State Thermal Transmission Properties by Means of the Guarded Hot Plate".		§ 456.810.
*ASTM C–236–66 (Reapproved 1971)	"Standard Test Method for Thermal Conductance and Transmittance of Built-up Sections by Means of the Guarded Hot Box".		§ 456.810.
ASTM C–516	"Standard Specification for Vermiculite Loose Fill"	Nov. 1, 1979	§ 456.806.
*ASTM C–518–76	"Standard Test Method for Steady State Thermal Transmission Properties by the Means of Heat Flow Meter".		§ 456.810.
ASTM C–520	"Standard Method for Density of Granular Loose-fill Insulation"	Nov. 1, 1979	§ 456.806 and § 456.807.
ASTM C–570–72	"Specification for Oil and Resin Based Caulking Compound for Building Construction"	Nov. 1, 1979	§ 456.812.
ASTM C–578	"Standard Specification for Preformed, Block-Type Cellular Polystyrene Thermal Insulation".	Nov. 1, 1979	§ 456.808
ASTM C–755–73	"Standard Recommended Practice for Selection for Vapor Barriers for Thermal Insulation".	Nov. 1, 1979	§ 456.803.
*ASTM C–790–74	"Standard Recommended Practices for Use of Latex Sealing Compounds"		§ 456.916.
*ASTM C–792–75	"Standard Test Method for Effects of Heat Aging on Weight Loss, Cracking, and Chalking of Elastomeric Sealants".		
*ASTM C–797–75	"Standard Recommended Pratices and Termonology for Use of Oil-and Resin-Based Putty and Glazing Compounds".		§ 456.916.
*ASTM C—804–75	"Standard Recommended Practices for Use of Solvent Release Type Sealants"		§ 456.916.
ASTM C–834–76	"Specification for Latex Sealing Compounds"	Nov. 1, 1979	§ 456.812.
*ASTM D–257–78	"Test for DC Resistance or Conductance of Insulating Materials"		§ 456.810.
*ASTMD–1622–63 (Reapproved 1975)	"Standard Method of Test for Apparent Density of Rigid Cellular Plastics"		§ 456.810.
ASTM E–84	"Standard Test Method for Surface Burning Characteristics of Building Materials"	Nov. 1, 1979	§ 456.808; § 456.809; § 456.810 and § 456.812.
ASTM E–96	"Standard Test Method for Water Vapor Transmission of Materials in Sheet Form"	Nov. 1, 1979	§ 456.805.
ASTM E–119–76	"Standard Methods of Fire Tests of Building Construction and Materials"	Nov. 1, 1979	§ 456.906 and § 456.907.
ASTM E–136–79	"Test for Non-Combustibility of Elementary Materials"	Nov. 1, 1979	§ 456.905 and § 456.906
ASTM E–283–73	"Standard Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors".	Nov. 1, 1979	§ 456.813.
ASTM E–576–76	"Standard Test Method for Dew/Frost Point of Sealed Insulating Glass Units in Vertical Position".	Nov. 1, 1979	§ 456.813.

Table of Standards—Continued

Number	Title	Date approved	Section reference
*ASTM G 1-72	"Standard Recommended Practice for Preparing, Cleaning, and Evaluating Corrosion Test Specimens".		§ 456.810.
BPCA: BOCA Research Report No. 72-23		Nov. 1, 1979	§ 456.813.
EPA: EPA Report No. 600/2-75-069a	"Guidelines for Residential Oil Burner Adjustments"	Nov. 1, 1979	§ 456.913
Federal Specifications:			
HH-I-515 D	"Insulation, Thermal (loose-fill for Pneumatic or Poured Application): Cellulosic or Wood Fiber".	Nov. 1, 1979	§ 456.803; § 456.804 and § 456.805.
HH-I-524 B	"Insulation Board, Thermal (Polystyrene)"	Nov. 1, 1979	§ 456.808.
HH-I-530 A	"Insulation Board, Thermal (Polyurethane and Polyisocyanurate)"	Nov. 1, 1979	§ 456.809.
HH-I-558 B	"Insulation Blocks, Boards, Blankets, Felts, Sleeving, and Pipe Fitting Coverings"	Nov. 1, 1979	§ 456.812.
*HH-I-573 B	"Organic Cellular Flexible Unicellular Pipe Covering"		§ 456.812.
HH-I-574 B	"Insulation, Thermal (Perlite)"	Nov. 1, 1979	§ 456.807.
HH-I-585 C	"Insulation, Thermal (Vermiculite)"	Nov. 1, 1979	§ 456.806
HH-I-1030 A	"Insulation, Thermal (Mineral Fiber for Pneumatic or Poured Application)"	Nov. 1, 1979	§ 456.804 and § 456.805.
HH-I-1252 B	"Insulation, Thermal Reflective (Aluminum Foil)"	Nov. 1, 1979	§ 456.810.
TT-S-001543 A	"Sealing Compound, Silicone Rubber Base, (for Caulking, Sealing, and Glazing in Buildings and Other Structures)".	Nov. 1, 1979	§ 456.812.
TT-S-00227 E	"Sealing Compound, Elastomeric Type, Multi-Component (for Caulking, Sealing, and Glazing in Buildings and Other Structures)".	Nov. 1, 1979	§ 456.812.
TT-S-001657	"Sealing Compound, Single Component Butyl Rubber Base, Solvent Release Type (for Buildings and Other Types of Construction)".	Nov. 1, 1979	§ 456.812.
TT-S-00230 C	"Sealing Compound, Elastomeric Type, Single-Component, (for Caulking, Sealing and Glazing in Buildings, and other Structures)".	Nov. 1, 1979	§ 456.812.
TT-C-00598 C	"Caulking Compound, Oil and Resin Type (for Building Construction)"	Nov. 1, 1979	§ 456.812.
TT-P-00791 B	"Putty Linseed-oil Type, (for Wood-Sash-Glazing)"	Nov. 1, 1979	§ 456.812.
FHDA: FHDA 6-77	"Industry Standard for Douglas Fir, Western Hemlock, and Sitka Spruce Doors and Blinds".	Nov. 1, 1979	§ 456.813.
HUD: HUD Intermediate MPS Supplement 4930.2.	"Solar Heating and Domestic Hot Water Systems"	Nov. 1, 1979	§ 456.702; § 456.703 and § 456.704.
NBS: NBS/PS 26-70	"Rigid Polyvinyl-chloride Profile Extrusions"	Nov. 1, 1979	§ 456.813.
NFPA: NFPA-31	"Standard for the Installation of Oil Burning Equipment"	Nov. 1, 1979	§ 456.905, § 456.906, § 456.907, § 456.909 and § 456.913.
NFPA-54	"National Fuel Gas Code"	Nov. 1, 1979	§ 456.905, § 456.906, § 456.907, § 456.909, and § 456.914.
*NFPA-70-1978	"National Electric Code"		§ 456.905 and § 456.914.
NFPA-211	"Standard for Chimneys, Fireplaces, and Vents"	Nov. 1, 1979	§ 456.905, § 456.906, § 456.907, § 456.909 and § 456.912.
*Sandia Laboratories Report SAND 77-1375.	"Performance Evaluation of Wind Energy Conversion Systems Using the Method of Bins.".		§ 456.705.
UL: UL 599	"Standard for Heat Pumps"	Nov. 1, 1979	§ 456.814.

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